An Investigation of the Quality of Illinois Grown Wheat

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INTRODUCTION

WHEAT IS GROWN primarily for human consumption. It owes its popularity as an article of human diet partly to its mild and pleasant flavor, partly to its high nutritive value, and partly to the physical and chemical properties of the flour milled from it. Because of the peculiar physical and chemical properties of the flour, widely divergent articles of food may be made from it, ranging from the relatively solid spaghetti and macaroni to spongy bread lightened with yeast, light, fluffy biscuits and cake, and crisp, flaky pie crust and crackers.

For the above purposes there is no satisfactory substitute for wheat. Neither is there any one kind of wheat that yields flour equally well suited to all these purposes. From durum wheat is milled semolina, used in the manufacture of spaghetti and macaroni. The hard spring and winter wheats yield flour preeminently suited for making bread lightened with yeast, while from the soft wheats is produced flour especially adapted for biscuit, pastry, and cracker making.

Wheat flour owes its peculiar properties to one of its constituents known as gluten. This is the somewhat gummy substance which remains in the mouth when one chews a quantity of raw wheat. The wide variations in the behavior of flour from different wheats is largely the result of variations in the amount and the quality of the gluten contained in them. On the basis of these two factors—quantity and quality of gluten—flours are generally divided into two classes known as *strong* and *weak,* with various gradations between the two.

The definition commonly given for a strong flour is that suggested by Humphries[1]—one capable of making "large, well-piled loaves." The term "well-piled" is used here to indicate a soft, spongy condition of the crumb, silky in appearance and to the touch. This definition of strength implies not only the capacity to make large loaves but also loaves with good texture. However, a flour may possess an abundance of gluten of excellent quality and yet fail to make a good loaf, owing to the inability of the yeast to function properly in that particular

[1]Humphries, A. E. The improvement of English wheat. Natl. Assoc. of British and Irish Millers. 1905.

flour. In defining flour strength, Bailey[1] has proposed that this term signify that quality which permits an abundant evolution of gas in the dough with a corresponding capacity to retain it.

The principles involved in the making of what is commonly known as light bread are briefly these: The flour is mixed with the proper amount of liquid (water or milk), yeast, salt, sugar, and shortening. When the resulting dough is kept at the proper temperature the yeast, which is a one-celled organism, becomes active and rapidly reproduces itself thruout the entire mass. The yeast feeds primarily upon the sugar present in the flour. The final products of the breaking down of the sugar by the yeast are carbon dioxid gas (CO_2) and alcohol. The gas accumulates within the minute interstices between the particles making up the mass of dough. As the fermentation proceeds, the gas-filled bubbles gradually increase in number and size. If the amount of gluten is sufficient and of good quality, the dough will become a mass of small thin-walled cells of more or less uniform size. If, however, the gluten is lacking in quantity or quality, the cell walls will break, allowing the gas to gather in large pockets and much of it to escape. Under these conditions the cell walls run together and become thickened. The resulting loaf when finally baked is heavy, of small size, and altogether unattractive and unpalatable.

Wheat contains a ferment known as diastase, which when the kernels or the resulting flour is moistened, operates to convert a portion of the starch into a kind of sugar. Occasionally flour made from certain lots of wheat is deficient in the amount of this ferment. During the later stages of the period of fermentation the yeast, which has already consumed the initial supply of sugar in the dough, is dependent on additional sugar being converted from the starch for its source of energy for growth. It follows, then, in the case of a flour deficient in diastatic activity, that when the dough is given the final kneading and placed in the pan to rise, it has largely lost its ability to lighten, not necessarily because of the lack of gluten or the quality of the gluten but because of failure to convert starch into suitable food for the yeast. Thus proper diastatic activity is an important factor in a bread flour.

Criticism of Illinois Hard Wheat

During recent years there has been considerable criticism of Illinois wheat. This criticism has come largely from certain millers and

[1]Bailey, C. H. A method for the determination of the strength and baking qualities of wheat flour. Jour. Indus. Engin. Chem. **8**, 53-57. 1916.

grain dealers who formerly secured considerable supplies of soft wheat from central Illinois, where now the major portion of the wheat grown is hard. These critics refer to Illinois hard wheat as "mongrel." They state that under Illinois conditions hard wheat deteriorates and becomes neither hard nor soft; that it possesses too much of the characteristics of hard wheat to produce good soft-wheat flour, while it is too soft to yield a good grade of hard-wheat flour. If this is true, then there is a large amount of inferior wheat produced in Illinois. Whereas formerly soft wheat was the only winter wheat grown in the state, now probably the major portion of the winter wheat produced in the northern two-thirds of the state comes under the classification of hard winter wheat.

This criticism does not apply to the soft wheat grown in Illinois, as the soft wheat apparently mills into flour which fulfills the requirements of the soft-wheat flour trade.

Object of Investigation

Wheat investigations have constituted a major project of the Illinois Station from the time it was established to the present date. These investigations have dealt chiefly with cultural practices and variety studies in which results have been measured by yield of grain to the acre. Recent years have seen a marked advance in the standardization of flour grades whereby the miller is enabled to produce, year after year, flour of uniform quality to meet the particular requirements of his trade. Since much attention is therefore being given to the composition of wheat and the quality of the flour which it will make, it seemed advisable to extend the scope of the wheat studies to include an investigation of the composition of Illinois wheats and their milling and baking qualities.

In considering the data presented, it is needful to keep in mind the several objectives of the project and the relative emphasis to be placed upon the data secured. The varietal studies of the wheat grown on the various experimental plots were made primarily to determine the relative value of certain varieties of wheat, both winter and spring, for making yeast-lightened bread. Incidentally, where the same varieties were grown on more than one field in the same year, opportunity was afforded to study the influence of environment on the quality of the wheat; and where varieties were grown on the same field in different years, it was possible to gain some idea of the effect of seasonal conditions on the composition and quality of the grain. The tests made with samples of wheat obtained direct from farmers

and from carlot shipments received at the St. Louis and Indianapolis markets furnished an opportunity to ascertain the quality of the wheat grown commercially in central and southern Illinois. The tests made with wheat produced in Illinois from seed grown in other parts of the United States, tho limited, suggest something of the relative quality of such wheat as compared with the original seed.

Conclusions of Other Investigators Regarding Factors Affecting Quality of Wheat

Illinois farmers are interested in hard red winter wheat, soft red winter wheat, and to a less extent in hard red spring wheat, these being the only classes grown in Illinois in any considerable amount.

Relative Value of Different Classes and Varieties.—Many investigations have been conducted to determine the relative value of the different classes of wheat and of different varieties within classes. In general, investigators are agreed that hard red spring wheat ranks first in the strength of the flour milled from it, that hard red winter is a close second, while soft red winter produces flour of less strength. There is considerable variation in the bread-making qualities of the varieties within the different classes, thereby causing considerable overlapping of classes. Among the spring wheats extensively grown, Marquis is generally credited with producing flour of the highest quality for bread making. Turkey Red, Kharkov, and Kanred, all practically identical in physical characters, rank high among the hard red winter wheats, while Red Rock is said to be of superior bread-making quality among the soft red winter varieties. Other soft varieties also have their champions, prominent among which is Trumbull, a selection from Fultz.

One of the most extensive studies of the milling and baking value of American wheat classes and varieties was reported by Shollenberger and Clark.[1] In one of the opening paragraphs of their bulletin, they state that: "The effects of season, locality, rainfall, elevation, and soil are generally of less importance than varietal differences. The data presented . . . should be useful to the producer in determining the best varieties to grow and when identification is possible, should be useful to the wheat buyer and miller in selecting and blending wheats to meet particular milling and baking requirements." On the other hand, Kiesselbach,[2] in commenting concerning the results

[1]Shollenberger, J. H., and Clark, J. A. Milling and baking experiments with American wheat varieties. U. S. Dept. of Agr. Bul. 1183. 1924.

[2]Kiesselbach, T. A. Winter wheat investigations. Nebr. Agr. Exp. Sta. Res. Bul. 31. 1925.

secured at the Nebraska Station in which eleven varieties of hard wheat were compared with ten varieties of soft wheat, states: "From these results it appears that when the hard and soft red winter wheats are grown comparably, under identical soil and climatic conditions, the inferiority of the soft group in milling and baking quality is not very striking, and nearly equal milling and baking values may be expected. Inferior yields rather than decidedly inferior milling and baking values caused the soft red wheats to be decidedly less desirable than the hard red wheats under these uniform conditions." It should be noted, however, that Kiesselbach recognized varietal differences, for he states further that "the individual variety variations shown . . . . are of considerable interest and suggest a distinct advantage for some varieties."

Influence of Environment.—Many investigators have studied the effect of climate and of soil and soil treatment upon the composition and the milling and baking quality of wheat. From these investigations the following conclusions may be drawn:

(a) Cool weather with sufficient well-distributed precipitation during the period from head formation to maturity, retards ripening and affords conditions favorable for the continued formation of carbohydrates (sugars) and their deposition in the form of starch in the kernels. Such kernels are plump and may be low in protein. On the other hand, hot, dry summers hasten maturity and tend toward the formation of smaller kernels of higher protein content.

(b) To the extent that it affects the fertility of the soil or the amount and availability of the moisture, the soil type may have an effect upon the composition of the wheat grain. A soil capable of holding sufficient readily available moisture induces prolonged vegetative growth with the consequent continued starch formation and deposition in the kernel.

(c) The abundance or lack of plant-food elements in the soil may materially affect the composition of wheat. Probably the element having the most effect is nitrogen. When there is an abundant supply of available nitrogen until the grain is mature, high-protein grain may be formed even tho climatic conditions favor low-protein grain. The consensus of opinion is that regardless of variety, the composition of the crop is largely determined by the environment during the growing season and especially during the later stages of growth.

Climate of Illinois Favorable to Low-Protein Wheat

Since climate is such a vital factor influencing the composition of wheat and the baking quality of its flour, it is worth noting that the

average precipitation in Illinois ranges from 34 inches in the extreme northern district to 43 inches in the extreme southern district. In all sections of the state the period of head formation and development is normally a season of abundant rainfall. Such climatic conditions are favorable for the production of soft, starchy wheat.

Climatic conditions during the winter are apt to be severe. This is particularly true in the northern and the central sections. The lowest temperatures are attained in the northern part of the state, but in that region it is more consistently cold and the snow remains on the ground longer than in the central section. In the central section the ground is usually bare most of the winter, and extreme and very sudden changes in temperature frequently occur. The production of the ordinary soft-wheat varieties under such conditions is attended by considerable risk, hence the increasing popularity of hard wheat among growers located in central and northern Illinois.

MILLING AND BAKING EQUIPMENT AND METHODS

The milling equipment used in the present investigations consisted of a Wolf outfit. This included a scourer, a disk aspirator, and a roller mill. The mill was provided with two sets of 6-inch rolls. One set was corrugated and the other smooth. The mill was run by a 5-horsepower electric motor.

The baking laboratory was equipped with a Despatch electric baking oven, a Despatch electric proofing cabinet having an automatic heat control, a Hobart 3-quart electric dough mixer, and an apparatus for determining loaf volume.

The chemical laboratory was supplied with the apparatus necessary for all the ordinary analytical work required in such an investigation.

Method of Milling.—The quantity of any one sample of wheat that could be conveniently milled with the apparatus described and at the same time would yield sufficient flour for the various tests ranged from 1,500 to 2,000 grams (approximately 3.3 to 4.4 pounds).

Before beginning the milling process, the wheat was scoured and tempered. The scouring machine rubbed and knocked loose the dust and dirt adhering to the kernels and also removed portions of the outer layer of the bran. A strong current of air drew these off to the dust chamber and at the same time separated the light shriveled kernels and weed seed from the good grain.

Wheat was tempered previous to milling by moistening it with

water and allowing it to stand for a time. It was necessary to determine the moisture content of the grain before tempering; then, knowing the amount of water already in it, sufficient water was added to bring the content up to 14 percent in the case of soft wheat and to 15 percent in the case of hard wheat. After adding the water, the whole was thoroly mixed and then allowed to stand covered for several hours. Tempering not only softens the floury portion of the kernel, thus rendering it more easily ground into flour, but it also toughens the outer covering of the kernel and permits the corrugated rolls to crack open and scrape the floury portion free from the bran without finely pulverizing it.

Having cleaned and tempered the grain, it was ready for the mill. The first series of operations consisted in passing it thru the corrugated or break rolls five times. Between each break the crushed grain was sifted over coarse wire screens which removed the middlings. No. 16 wire screen was used after the first two breaks, No. 18 after the third, and No. 20 after the fourth and fifth breaks. For the first break, the rolls were rather wide apart and merely cracked the kernels open. With each successive break the rolls were brought closer together until for the last they almost touched. The result was that the outer covering of the wheat was flattened and scraped practically free from the floury portion. That which remained upon the No. 20 wire screen after the fifth break went to the bran, while the middlings which passed thru were combined. These were separated into various grades by sifting over Nos. 30, 50, 64, and 72 grit gauze, and thru a No. 12xx flour sieve. That portion passing thru the No. 12xx flour sieve constituted the *break* flour. The various grades of middlings were successively put thru the smooth or reducing rolls and sifted. That passing thru a No. 11xx flour sieve constituted *middlings* flour. When the middlings had been reduced to the point where further reduction would injure the quality of the flour, that remaining on top of No. 11xx after passing thru No. 72gg was set aside as *tailings* flour. The portion that remained on the No. 72gg was again passed thru the reducing rolls and sifted thru No. 72gg. The portion passing thru the sieve went to the tailing flour, while the overs constituted the shorts. The break flour mixed with the middlings flour constituted the sample which, in most of this work, was used for the baking test. In some of the first work recorded in this bulletin, middlings flour only was used for the baking test. A record of the weight of the three grades of flour was kept, but in the tables which follow, only the percentage of total flour based upon weight of grain milled is given.

Baking Methods.—In conducting the baking tests, conditions were maintained as nearly uniform as possible with but two exceptions. The amount of water added in making up the dough and the time of proofing varied with the sample of flour. The formula employed was as follows:

Flour	340 grams
Yeast	10 grams
Sugar	15 grams
Salt	5 grams

Sufficient water to make a dough of the proper consistency

The flour was weighed into 2-quart bowls, covered, and placed in the fermentation cabinet. The proper amount of sugar and salt for each loaf was placed in beakers and also put in the cabinet. The materials were allowed to remain in the cabinet (usually over night) until they reached a constant temperature of 90° F. When all was in readiness for mixing, the flour for a single loaf was transferred to the bowl of the electric dough mixer. The salt and sugar were dissolved in distilled water previously heated to 90° F., the yeast was stirred up in another portion of the warm distilled water and the whole was added to the flour together with sufficient additional water to bring the dough to the proper consistency.

About three to four minutes of continuous mixing at low speed was required. The dough was then removed from the mixer, molded by hand into a ball, and returned to the original bowl which had previously been greased. Bowl and contents were covered and returned to the cabinet. The dough was fermented for 45 minutes at a temperature of 90° F., at the end of which time it was knocked down and then given another 45-minute fermentation period. After the second fermentation period it was thoroly kneaded, made into a loaf, and placed in a tall form of laboratory bake pan. It was again returned to the cabinet and allowed to proof until it nearly reached its maximum expansion. At this stage it was placed in the electric oven and baked at 420° F. for 35 minutes.

One hour after removal from the oven the loaf was weighed and the loaf volume determined. The latter determination was made by placing the loaf in a container the capacity of which was known. The space around the loaf was filled with flax seed and the surface struck off level. The difference between the known capacity of the container and the volume of the flax seed required to fill the container when the loaf was in it, represented the volume of the loaf.

The following day the loaf was cut and scored for color of crumb and for texture.

EXPLANATION OF TERMS

The following explanation is given in order that the reader may better understand the significance of certain terms commonly used by cereal chemists in evaluating wheat and the baking strength of the flour milled from it.

Crude Protein.—This term includes all organic nitrogenous substances contained in the wheat kernel or the flour milled from it. Gluten constitutes the major portion of the crude protein of flour and is the essential constituent. Crude protein can be determined with greater rapidity and accuracy than can gluten; hence, protein determinations are usually substituted for gluten tests and the amount of protein found serves as a reliable index of the gluten content. The crude-protein content of wheat is greater than that of the flour milled from it because the bran removed in the milling process is richer in protein content than the floury portion of the grain.

Gluten is made up of two proteins known as gliadin and glutenin. When ground wheat is moistened with water and mixed into a dough, these two compounds unite to produce a gummy substance known as gluten. It is because of the presence of this substance, which is contained in no other cereal, that the flour from wheat is peculiarly adapted for the making of the various kinds of bread, pastry, and edible pastes which constitute so important a part of the diet of most civilized peoples. It is this substance that gives coherence to the mass of dough and causes it to retain the gas developed within it. The adaptation of flour for a specific purpose depends upon the amount and quality of the gluten it contains. A strong flour, one containing considerable gluten of excellent quality, is desirable for making bread lightened with yeast. A flour containing less gluten or gluten of inferior quality is less retentive of the gas, and the dough reaches its maximum expansion without attaining sufficient size. The result is a small loaf, more or less heavy in texture, and unpalatable. If, however, the flour is to be used for making biscuits or pastry, it is lightened with quick-acting chemical agents, such as baking powder, and less ruggedness is required. In this case expansion takes place within the oven and must be completed quickly before the dough or batter becomes set by the heat. It follows then that the term *quality,* when applied to a strong bread flour, may mean inferiority if the flour is used for quick bread or pastry. On the other hand, a first-class biscuit or pastry flour requires careful handling in order to make good bread lightened with yeast.

Ash.—This is the white or grayish substance remaining after all

the combustible portion of the flour has been burned away. Since the endosperm, or floury portion of the kernel contains less ash than the bran and germ, and since it is impossible in the milling process to obtain a complete separation of the endosperm from these other parts, the ash content of the flour is taken as an indication of its grade or degree of refinement.

Loaf Volume.—While the chemical analysis of wheat and of the flour milled from it are of much assistance to the miller in producing flour of the desired quality, final judgment on a bread flour must be based upon the character of the loaf baked from it. The method of conducting the baking tests outlined in the preceding pages was not designed for the purpose of making the best possible loaf of bread from each sample of flour. It was intended to test the strength of the flour, that is, the ability to develop an abundance of carbon dioxid gas and to retain it, with the resultant formation of large loaves of good texture as compared with the loaves made from a good standard flour. By the use of the proper ingredients in the formula, by care exercised in mixing and kneading the dough, and by a nice adjustment of the fermentation time, it is possible to make fair to good bread from flour ordinarily regarded as too weak for good bread. A weak flour, however, is considered unfit for use in the big bakeries, where large batches of dough are mixed in high-speed mixers. For such use a flour must have gluten of sturdy constitution in order to withstand the severe stretching and tearing to which the dough is subjected. In these experiments it has been found that when bread has been made according to the above formula and the dough has been fermented two periods of 45 minutes each and finally proofed in the tall form of bake pan, where expansion is chiefly confined to one direction (upward), very considerable strength or quality of gluten is required if the loaf emerges from the oven possessed of large volume and of good texture. At each baking a check or standard loaf was made from a well-known bread flour. This flour regularly withstood the conditions imposed upon it and made a loaf of large size and of excellent texture. The samples of wheat which produced the strongest flour equalled or nearly equalled, and occasionally even surpassed the standard loaf in volume and texture. The flour from many samples of wheat lacked ruggedness and made inferior loaves, while others were intermediate in strength.

For the purpose of affording definiteness in this discussion, certain volumes have been arbitrarily taken to define the limits of the different grades of strength. A loaf volume of 1,900 cc. or more is regarded

as *good* to *excellent,* 1,800 to 1,899 cc. as *medium,* and any volume less than 1,800 cc. as *inferior* in size. With these figures in mind the data may be more readily interpreted without a definite statement in each case. It should be recognized, however, that in the ultimate quality rating the size of loaf should be associated with good texture.

Texture.—A loaf of good texture should have rather small cells of uniform size, the walls of which are thin and should possess a sheen. When pressed with the fingers the crumb should feel soft and springy.

Color of Crumb.—Popular sentiment favors a loaf the crumb of which is white or pale cream. Much of the flour consumed is bleached for the purpose of rendering it white. A yellow tint is imparted to flour by a pigment known as carotin. It is particularly abundant in hard red winter wheat. A grayish cast to the crumb may usually be attributed chiefly to imperfections in the milling, due either to incomplete cleaning of the wheat or to the inclusion of fine bran particles in the flour. As in the estimation of the texture, the color score is determined by comparing the color of the crumb of each loaf with that of a standard loaf baked the same day.

Absorption.—Different lots of flour vary in the amount of water required to bring the dough to a uniform and proper consistency. Flour is composed chiefly of starch and the nitrogenous compounds which form gluten when moistened. The gluten in flour absorbs relatively much more water than does starch. Also, the amount of water absorbed by the gluten is influenced by both the amount and the quality of the gluten. Hence the amount of water absorbed is regarded to some extent as a measure of the strength of the flour. The chief importance of a large water-absorbing capacity, however, lies in the fact that it permits the production of a greater number of standard-weight loaves of bread from a given weight of flour than does one of lesser absorptive capacity. This fact is of considerable economic importance to the baker.

YIELDS OF GRAIN AND BREAD-MAKING QUALITIES OF VARIETIES GROWN ON THREE ILLINOIS EXPERIMENT FIELDS

Varieties From Urbana Field in Central Illinois

A summary of the yields of grain and of the milling and baking qualities of all wheat varieties grown for three or more years at Urbana is given in Table 1. Varieties grown during the same years

TABLE 1.—COMPARATIVE MILLING AND BAKING QUALITIES OF VARIETIES OF WINTER WHEAT GROWN ON EXPERIMENT FIELD AT URBANA, CHAMPAIGN COUNTY
(Data summarized from Table 14 of the Appendix)

Variety	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
	Before cleaned	Cleaned for milling		Wheat	Flour							
Varieties tested during 1922-1926												
Hard red winter	*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
Minnesota Reliable	59.9	....	74.7	11.93	10.49	....	54.3	474	**1 870**	96.8	....	**43.7**
Turkey Red (Station)	60.4	....	73.3	**12.10**	10.59	....	53.9	478	1 840	95.8	....	39.8
Kanred	58.6	....	73.6	11.96	10.81	....	55.5	484	1 750	95.8	....	41.9
Blackhull	61.4	....	74.2	11.80	10.64	....	52.9	473	1 735	96.4	....	43.8
Ilred	59.9[1]	....	71.9	11.52	10.48	....	55.0	483	1 730	96.2	....	42.4
Worlds Champion	59.9	....	73.3	11.61	10.43	....	54.7	481	1 725	97.4	....	42.8
Average	60.0	....	73.5	11.82	10.57	....	54.6	479	1 775	96.4	....	42.4
Soft red winter												
Michigan Amber	59.3	....	71.0	11.94	10.39	....	55.0	486	1 710	97.2	....	40.7
Gladden	59.8	....	71.4	11.50	10.44	....	52.4	478	1 625	96.8	....	42.0
Average	59.6	....	71.2	11.72	10.41	....	53.7	482	1 665	97.0	....	41.3
Varieties tested during 1922-1925												
Hard red winter												
Minnesota Reliable	59.7	....	75.0	**11.97**	10.39	....	55.2	478	**1 860**	96.5	....	43.2
Turkey Red (Station)	60.0	....	72.9	11.90	10.27	....	54.6	479	1 810	95.3	....	39.0
Kanred	58.0	....	72.7	11.93	10.70	....	56.3	484	1 720	95.5	....	39.7
Malakof 5-460	58.9	....	72.5	11.62	10.07	....	55.3	479	1 700	96.5	....	40.4
Ilred	....	....	71.2	11.38	10.22	....	55.5	482	1 685	96.0	....	41.2
Worlds Champion	59.8	....	73.2	11.50	10.12	....	55.3	483	1 660	**97.3**	....	42.5
Blackhull	61.7	....	74.4	11.69	10.34	....	53.0	472	1 650	96.3	....	**45.0**
Average	59.7	....	73.1	11.71	10.30	....	55.0	479	1 725	96.2	....	41.6
Soft red winter												
Indiana Swamp	60.6	....	73.5	11.73	10.31	....	55.4	484	1 850	96.8	....	43.4
Red Cross	59.8	....	68.5	11.68	.....	....	52.9	478	1 735	97.5	....	39.9
Michigan Amber	59.0	....	70.7	11.86	10.07	....	56.1	489	1 695	97.0	....	41.5
Gladden	60.1	....	70.8	11.35	9.78	....	53.0	479	1 600	97.0	....	41.7
Dawson Golden Chaff 9-225	59.0	....	73.5	11.05	9.44	....	52.3	472	1 600	96.3	....	42.3
Average	59.7	....	71.4	11.53	9.90	....	53.9	480	1 695	96.9	....	41.8

[1]Average of four years.

TABLE 1.—*Concluded*

Variety	Weight per bushel		Flour yield	Crude protein (N×5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
	Before cleaned	Cleaned for milling		Wheat	Flour							
Varieties tested during 1923-1926												
Hard red winter												
Michikof	61.1	63.0	71.1	13.23	.....	.471	54.8	480	**2 010**	96.5	97.8	41.2
Minnesota Reliable	59.9	....	74.7	12.47	11.03	....	53.2	471	1 940	96.8	98.3	43.6
Hardy Northern	....	....	71.5	12.56	11.12	....	52.9	475	1 905	97.0	96.8	38.4
Malakof C. I. 4898	59.8	....	74.9	**13.29**	11.56	....	52.1	469	1 875	94.0	93.5	39.4
Red Russian	60.1	....	75.8	12.50	10.93	....	53.6	475	1 865	95.0	94 8	**44.8**
Blackhull	61.4	....	74.5	12.25	11.06	....	53.0	471	1 820	96.5	96.5	43.1
Turkey Red (Station)	60.8	....	74.6	12.60	11.00	....	53.1	473	1 790	96.0	98.0	40.9
Worlds Champion	60.3	....	74.1	12.13	10.97	....	54.3	475	1 740	97.5	98.5	43.4
Ilred	....	....	74.9	11.99	10.86	....	54.2	479	1 735	96.0	96.8	44.1
Kanred	59.1	....	75.1	12.26	11.11	....	55.6	483	1 715	96.3	97.0	43.5
Average	60.3	....	74.1	12.53	11.07	....	53.7	475	1 840	96.2	96.8	42.2
Soft red winter												
Michigan Amber	59.4	....	71.4	12.41	10.87	....	54.5	484	1 665	97.0	96.8	41.0
Gladden	59.7	....	72.2	12.06	10.69	....	52.1	478	1 600	96.3	93.3	42.6
Average	59.6	....	71.8	12.24	10.78	....	53.3	481	1 633	96.7	95.1	41.8
Varieties tested during 1924-1926												
Hard red winter												
Michikof	60.7	62.9	72.3	**13.63**	.....	.488	55.4	480	**2 005**	96.7	98.0	41.2
Minnesota Reliable	60.7	62.6	74.5	12.11	10.92	.498	53.0	475	1 935	97.3	98.3	43.8
Malakof C. I. 4898	60.4	62.6	75.5	12.49	11.15	.466	52.7	472	1 885	94.3	92.3	40.0
Red Russian	60.5	62.6	76.0	12.20	10.75	.481	53.8	477	1 875	95.7	94.3	45.8
Hardy Northern	60.4	63.0	72.4	12.55	11.24	.466	53.3	476	1 875	97.0	97.3	39.6
Blackhull	61.8	63.6	74.2	11.95	10.93	.449	54.2	481	1 865	97.3	96.3	42.2
Minturki	60.6	62.4	75.3	12.11	10.93	.424	53.2	477	1 840	96.0	95.7	44.4
Worlds Champion	60.9	63.0	72.7	11.84	10.86	.428	54.1	480	1 800	97.7	98.3	43.1
Turkey Red (Station)	61.4	63.6	74.3	12.07	10.77	.430	53.0	478	1 785	97.0	98.7	42 6
Ilred	60.3	62.8	74.4	11.65	10.68	.463	54.5	485	1 740	96.7	97.3	44.9
Altara	61.4	63.8	75.4	12.04	10.57	.449	56.0	488	1 715	96.3	96.6	42.8
Kanred	60.1	62.9	76.5	11.77	10.87	.461	55.9	488	1 680	97.0	97.0	**46.2**
Average	60.8	63.0	74.5	12.20	10.88	.459	54.1	480	1 833	96.6	96.7	43.0
Soft red winter												
Berkeley Rock	57.9	60.9	73.8	13.20	12.02	.545	55.0	484	1 770	97.0	98.0	30.1
Trumbull	58.5	60.7	71.7	12.59	11.19	.429	52.2	476	1 755	96.7	94.0	36.1
Fulhio	59.8	61.7	74.9	12.38	10.97	.443	52.1	478	1 675	95.7	95.0	36.6
Michigan Amber	60.1	63.1	71.4	12.11	10.84	.455	54.4	487	1 650	97.3	97.3	39.6
Gladden	60.3	63.3	71.6	11.95	10.70	.455	52.3	482	1 645	96.7	92.7	**41.4**
Average	59.3	61.9	72.7	12.45	11.14	.465	53.2	481	1 699	96.7	95.4	36.8

are grouped together, and thus direct comparison of the different varieties with respect to their various characteristics are easily made. (Detailed data are given in Table 14 of the Appendix.)

Yields of Hard Varieties.—Minnesota Reliable gave the highest average yield of grain during the five-year period 1922-1926, Blackhull during the four-year period 1922-1925, Red Russian during the four-year period 1923-1926, and Kanred during the three-year period 1924-1926. Blackhull surpassed all other varieties in weight per bushel. This characteristic of Blackhull, together with its undoubted productiveness, has made it a popular variety in Kansas, where it originated. In Illinois an incipient enthusiasm for it was cut short by a somewhat severe winter in 1924, when it was demonstrated that Blackhull is less winter-hardy than other varieties of the Turkey Red type.

Flour Yields of Hard Varieties.—The hard varieties all gave very satisfactory yields of flour except in 1922, when some of them gave unusually low yields. The low flour yields of that year, probably are to be attributed to a difference in methods of milling (see footnote, Table 14).

Crude-Protein Content of Hard Varieties.—Turkey Red (Station) had the highest average protein content of those varieties grown during the five-year period 1922-1926, Minnesota Reliable slightly excelled during the four-year period 1922-1925, Malakof C. I. 4898 led by a small margin during the four-year period 1923-1926, while Michikof was the high-protein variety among those compared during 1924-1926.

There was a wide variation in the protein content from year to year. Conditions during the season of 1922 were unusually conducive to the production of low-protein wheat. That year the average protein content of seven varieties of hard wheat was 9.90 percent. The following year was a high-protein year and the average protein content of those same varieties was 13.39 percent, or 3.49 percent greater than the previous year. It is not unlikely that the wheat grown in these plots is usually higher in protein content than is the average wheat produced in this section of the state because the soil is kept in a high state of fertility, and the wheat is grown following the legume crop in a four-year rotation of clover or soybeans, wheat, corn and oats.

Loaf Volume of Hard Varieties.—There was wide variation in the baking strength of the flour milled from the hard wheats, as indicated by the volume of the loaves produced. Michikof and Minnesota Reliable stood out as the most consistent producers of loaves of good size.

Soft Wheats.—Of the soft wheats tested, Gladden, Michigan Amber, and Indiana Swamp proved to be winter-hardy, tho scarcely as winter-resistant as the varieties of the Turkey Red type, and they compared favorably with the hard varieties in average yield. The soft wheats as a class produced a somewhat lower yield of flour. Contrary to the common conception, the average protein content of the two classes of wheat differed but little, and in the period 1924-1926 (Table 1) the average of the soft varieties actually exceeded that of the hard varieties. Notwithstanding this, the soft wheats as a class produced flour of lower average strength, as indicated by loaf volume.

Such varieties as Indiana Swamp, Trumbull, Berkeley Rock, and Dawson Golden Chaff 9-225 at times showed considerable strength. They failed, however, to be consistent in producing loaves of good size.

Varieties From DeKalb Field in Northern Illinois

Fifteen varieties of wheat grown on the DeKalb field were tested for their milling and baking qualities over periods of one to five years. The data from this investigation are summarized in Table 2.

Excellent Yields of Grain From All Varieties.—Altho the yields of soft wheats averaged materially less than the hard wheats, all varieties gave excellent yields of grain. Blackhull, Michikof, Hardy Northern, and Turkey Red (Station) were the least productive of the hard varieties grown during the three-year period 1924-1926, yielding an average of 40.7, 41.1, 41.7, 41.8 bushels respectively, as compared with Ilred, 45.9 bushels, and Red Russian, 45.8 bushels.

All Varieties Distinguished by Strength of Flour.—All varieties of wheat grown on this field were distinguished by the strength of the flour produced from them as compared with the same varieties grown at Urbana. This was true notwithstanding the fact that the average protein content of all varieties was rather low. Minnesota Reliable, in particular, produced flour of uniformly excellent quality. Its loaf volume ranged from 1,990 cc. to 2,325 cc., and for two of the four years for which data are available the texture of crumb excelled the standard. Of the well-known hard varieties tested for more than two years, Ilred and Kanred displayed the least strength. Minturki, tested only two years, produced flour of medium quality.

Soft Wheats.—The soft varieties grown on this field usually made flour of good to excellent quality. During a four-year period Red Cross made an average loaf volume of 2,000 cc., while the texture of the crumb was excellent. Fulhio displayed medium strength, while

TABLE 2.—COMPARATIVE MILLING AND BAKING QUALITIES OF VARIETIES OF WINTER WHEAT GROWN ON EXPERIMENT FIELD AT DEKALB, DEKALB COUNTY
(Data summarized from Table 15 of the Appendix[1])

Variety	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
	Uncleaned	Cleaned		Wheat	Flour							
Varieties tested during 1923-1926												
Hard red winter	*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
Minnesota Reliable	58.4	....	70.4	**11.67**	10.17	....	53.9	473	**2 120**	97.3	100.0	43.0
Blackhull	60.1	....	74.9	11.44	9.99	....	53.7	475	2 035	97.3	98.5	39.4
Hardy Northern	59.2	....	72.2	10.78	9.58	....	53.0	475	2 030	96.3	99.0	41.1
Turkey Red (Station)	59.1	....	72.3	11.33	9.67	....	55.6	474	1 990	96.8	99.3	41.8
Red Russian	59.1	....	74.4	11.43	10.02	....	53.8	477	1 990	96.8	99.8	44.9
Ilred	58.8	....	70.3	10.85	9.55	....	54.4	476	1 975	96.3	97.0	**45.0**
Average	59.1	....	72.4	11.25	9.83	....	54.1	475	2 023	96.8	98.9	42.5
Varieties tested during 1924-1926												
Hard red winter												
Minnesota Reliable	58.6	61.1	72.6	**11.24**	9.93	.428	53.9	475	**2 100**	97.7	100.3	44.8
Blackhull	60.5	62.8	74.5	10.87	9.69	.419	54.0	481	2 065	97.3	98.7	40.7
Red Russian	59.4	61.7	74.0	10.95	9.77	.470	54.0	480	2 005	97.0	100.0	45.8
Turkey Red (Station)	59.2	61.6	71.8	10.66	9.45	.444	55.7	478	1 995	97.0	99.3	41.8
Michikof	60.8	63.4	73.7	11.19	10.31	.469	55.8	485	1 990	97.3	99.0	41.1
Hardy Northern	59.3	61.8	73.7	10.25	9.20	.449	53.2	481	1 990	96.7	99.3	41.7
Ilred	58.8	61.5	72.7	10.31	9.29	.428	54.8	479	1 930	96.3	96.3	**45.9**
Kanred	58.6	61.0	74.8	10.79	9.21	.433	54.7	480	1 920	96.7	98.0	45.5
Average	59.4	61.9	73.5	10.78	9.61	.442	54.5	480	1 999	97.0	98.9	43.4
Soft red winter												
Fulhio	58.7	60.8	72.1	10.54	9.63	.423	57.3	481	1 885	98.0	98.7	37.2
Trumbull	58.9	61.0	71.8	11.14	9.74	.414	52.6	474	1 845	97.0	100.3	35.2
Average	58.8	60.9	71.9	10.84	9.68	.418	55.0	477	1 865	97.5	99.5	36.2

[1]Data for 1922 crop are omitted because test weight and percentage of protein in the grain that year were not determined.

TABLE 3.—COMPARATIVE MILLING AND BAKING QUALITIES OF VARIETIES OF WINTER WHEAT GROWN ON EXPERIMENT FIELD AT ALHAMBRA, MADISON COUNTY

(Data summarized from Table 16 of the Appendix)

Variety	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
	Uncleaned	Cleaned		Wheat	Flour							
Varieties tested during 1922, 1923, 1925, and 1926												
Soft red winter	*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
Illini Chief	56.7	....	71.0	**11.07**	9.63	....	51.0	470	**1 816**	97.8	97.0	26.4
Fulcaster	58.5	....	70.8	11.02	9.32	....	52.1	474	1 815	97.5	97.7	27.3
Mediterranean	58.0	....	71.3	11.04	9.02	....	51.4	472	1 811	97.2	98.7	**27.4**
Average	57.7	....	71.0	11.04	9.32	....	51.5	472	1 814	97.5	97.8	27.0
Hard red winter												
Ilred	57.9	....	70.5	10.53	9.06	....	55.5	483	1 784	95.8	97.0	24.7
Blackhull	59.3	....	71.7	10.90	9.44	....	54.4	478	1 698	96.3	95.0	26.5
Average	58.6	....	71.1	10.72	9.25	....	54.9	480	1 741	96.0	96.0	25 6
Varieties tested during 1922 and 1923												
Soft red winter												
Marvelous	56.7	....	67.8	10.74	8.64	....	54.3	471	**1 922**	97.5	....	30.5
Gipsy	56.4	....	71.6	10.50	8.81	....	51.1	469	1 875	97.5	....	31.0
Fulcaster	58.6	....	68.5	11 35	9.36	....	50.6	466	1 843	97.5	....	33.2
Jersey Fultz	56.9	....	68.7	10.79	9.10	....	51.9	478	1 840	97.5	....	30 7
Illini Chief	56.8	....	68.7	**12.50**	10.50	....	50.0	471	1 832	98.0	....	30.5
Rudy	57.8	....	67.0	11.24	8.78	....	52.5	477	1 755	97.5	....	**35.0**
Mediterranean	58.2	....	69.7	11.28	8.98	....	51.1	471	1 697	97.5	....	34.3
Harvest Queen	57.4	....	65.7	11.82	9.95	....	57.6	484	1 623	97.0	....	25.0
Red Wave	54.9	....	69.4	9.82	8.00	....	50.0	467	1 457	97.5	....	32.2
Average	57.1	....	68.6	11.12	9.12	....	52.1	473	1 760	97.5	....	31.4
Hard red winter												
Ilred	57.5	....	67.8	11.63	9.67	....	56.0	477	1 840	96.5	....	26.6
Blackhull	59.0	....	70.8	12.04	10.26	....	54.6	473	1 647	96.0	....	30.8
Average	58.2	....	69.3	11.83	9.96	....	55.3	475	1 743	96.3	....	28 7
Varieties tested during 1925 and 1926												
Soft red winter												
Mediterranean	57.7	59.9	72.9	**10.79**	9.05	.496	51.8	474	**1 925**	97.0	98.0	20 5
Illini Chief	56.5	59.0	72.7	9.93	8.75	.462	52.0	468	1 800	97.5	98.0	22.3
Fulcaster	58.4	60.5	73.1	10.68	9.28	.470	53.6	482	1 787	97.0	98.0	21.4
Michigan Amber	57.4	60.2	71.3	10.32	8.93	.464	52.6	473	1 768	97.0	97.5	**25.3**
Trumbull	55.7	58.0	72.0	10.09	8.91	.447	51.0	470	1 760	97.0	98.5	20.3
Gladden	57.5	59.9	73.6	9.89	8.54	.439	52.3	476	1 745	97.5	98.5	25.0
Fulhio	56.9	59.3	74.8	10.39	9.00	.449	52.9	483	1 725	96.0	96.0	21.8
Shepherd	55.1	58.8	73.9	10.30	8.92	.469	54.4	486	1 682	97 0	96.5	19.7
Poole	56.3	58.9	72.9	.....	9.29	.472	52.2	478	1 668	96.5	97.5	20.6
Average	55.7	59.6	73.0	10.30	8.96	.463	52.5	477	1 762	96.9	97.6	21.9
Hard red winter												
Blackhull	59.5	62.3	72.5	9.74	8.60	.483	54.1	482	1 747	96.5	93.5	22.3
Ilred	58.2	60.1	73.1	9.42	8.43	.477	55.0	490	1 725	96.0	98.0	22.9
Average	58.8	61.2	72.8	9.58	8.52	.480	54.5	486	1 736	96.2	95.7	22.6

Trumbull's excellent record in 1925 and 1926 was marred by the inferior quality of the flour produced in 1924.

Purkof and Winter Fife, tested for only one year, yielded well and milled into flour that made loaves of good size and excellent texture.

Varieties From Alhambra Field in Southern Illinois

A number of varieties of soft wheat appear to be about equally well adapted to the southern section of the state. Tests conducted at Alhambra and at Fairfield indicate that Fulcaster, Illini Chief, Mediterranean, Jersey Fultz, Gladden, and Michigan Amber are good-yielding wheats in this section (Table 3). The wheat grown at Alhambra has averaged rather lower in weight per bushel and in percentage of flour than the same varieties grown either at Urbana or DeKalb.

Seasonal Variations in Protein Content.—The protein content of the varieties varied considerably from year to year. The years 1922 and 1925 were low-protein seasons, 1923 was a high-protein year, while the protein content of the 1926 crop was intermediate between that of 1923 and 1925. The loaf volume, however, was not closely correlated with the variations in protein content. Five of the 11 varieties grown during the two years 1922 and 1923 produced loaves of greater volume in 1922 from low-protein wheat than in 1923 from high-protein wheat. (Table 16, Appendix)

Four-Year Comparisons.—Of the five varieties which can be compared for four years, the three soft varieties, Fulcaster, Illini Chief, and Mediterranean, averaged practically equal in protein content and in loaf volume respectively (Table 3). Each of these soft varieties slightly exceeded the two hard varieties, Ilred and Blackhull, in protein content, and the loaves of the soft wheats considerably exceeded those of the hard wheats in volume. Ilred had a somewhat smaller protein content each year than did Blackhull; nevertheless it exceeded Blackhull in volume of loaf three of the four years.

Two-Year Comparisons.—Of the nine soft and two hard varieties tested in 1922 and 1923, Illini Chief was the highest in protein content and was one of five to produce loaves in excess of 1,800 cc. as the average volume. Marvelous, which produced the largest average loaf volume, was exceeded in protein content by all except Red Wave and Gipsy. Red Wave produced very inferior loaves both years.

In 1925 and 1926 eleven varieties were tested, six of which had not been tested before. These six varieties all made loaves of inferior size. Mediterranean and Illini Chief were the only varieties that averaged 1,800 cc. or more in volume of loaf during those years.

INFLUENCE OF SOIL TYPE ON QUALITY OF WHEAT

Quality of Samples Grown on Representative Soil Types in Southern Illinois

It is sometimes said that a certain variety of wheat is better adapted to a particular type of soil than are other varieties. This is in accordance with the well-known fact that the kind of native vegetation varies with the character of the soil.

In order to gain some information on this subject, a number of variety plots were sown during the fall of 1925 on several soil types representing large areas in the southern part of the state.[1] Five varieties of wheat were selected for the work. They included one hard variety, Ilred, and four soft varieties, Fulcaster, Michigan Amber, Fulhio, and Shepherd. Each variety was sown by hand in plots of four rows 20 feet long and 11 inches apart. The varieties were replicated four times in regular order, thereby making 16 rows of each. Each row was harvested by hand, tied in a bundle, and taken to Urbana, where it was threshed and weighed. A representative sample was taken of each variety from each field for milling and baking tests in order to determine whether type of soil influenced the quality of the grain.

The soils chosen for this investigation differed in character both of surface and of subsoil. For purposes of comparison, however, the fields are arranged in three groups according to the character of the subsoil, which in this case seemed the most important characteristic which groups of these soils had in common. Group 1 includes those soils with very compact, plastic, and slowly pervious subsoil; Group 2, those with a compact, medium-plastic subsoil; and Group 3, those with an open, friable subsoil.

The autumn of 1925 was unusually cool and rainy at wheat-seeding time. The wheat was therefore sown rather late. In several instances the soil was in unsatisfactory physical condition owing to heavy rains which packed it after the fields had been prepared for seeding. The fall remained so cool that the wheat made little growth before winter set in. This fact perhaps explains the superior average yield of the two hardiest varieties, Ilred and Michigan Amber.

There was no conclusive evidence that any one variety was peculiarly adapted to any one of these groups of soils except Ilred (Table 4). Ilred was the high-yielding variety on every field, but one, that had an open, friable subsoil. Shepherd produced the highest percent-

[1]The selection of plots for this phase of the study was made by Mr. E. A. Norton and Dr. R. S. Smith, of the division of Soil Physics.

TABLE 4.—VARIETIES RATING HIGHEST IN YIELD, PROTEIN CONTENT, AND LOAF VOLUME ON THIRTEEN FIELDS IN SOUTHERN ILLINOIS: FIELDS GROUPED ACCORDING TO CHARACTER OF SUBSOIL

(Data summarized from Table 17 of the Appendix)

	Character of subsoil	Location of field	Highest yielding variety	Highest percentage protein	Greatest loaf volume
Group 1	Very compact, plastic and slowly pervious subsoil	Effingham Mt. Vernon Patoka Ashley	Michigan Amber Shepherd Michigan Amber Shepherd	Fulhio Ilred Fulcaster Michigan Amber	Fulcaster Ilred Fulhio Fulcaster
Group 2	Compact, medium-plastic subsoil	Ernst Summerfield Albers Benton	Michigan Amber Michigan Amber Ilred Fulhio	Shepherd Shepherd Shepherd Ilred	Ilred Fulcaster Fulcaster Fulhio
Group 3	Open, friable subsoil	Centerville East Alton Pana Lawrenceville Albion	Ilred Ilred Ilred Ilred Fulhio	Michigan Amber Fulhio Shepherd Fulcaster Michigan Amber	Fulcaster Michigan Amber Michigan Amber Fulhio Fulcaster

age protein on three of the four fields having a compact, medium-plastic subsoil. Additional data are needed to confirm or disprove a relative adaptation of any of these varieties for a particular group of soils.

Quality of Samples Grown on Two Soil Types in Central Illinois

Another opportunity to study the effect of soil type upon the yield and quality of wheat was afforded thru the courtesy of Mr. C. E. Hay, formerly farm adviser in Christian county. During the season of 1925 Mr. Hay conducted variety tests of wheat on two widely different types of soil in his county, which is located in central Illinois. These fields were sufficiently near each other that differences in climatic conditions, including rainfall, were probably of minor importance. One of these series of plots was located on the soil type designated as Grayish Brown Silt Loam On Clay. It had satisfactory drainage but was not particularly fertile. The other series of plots was placed on Black Clay Loam On Clay. It is what is known as a young soil, having formerly been covered with water. It should naturally be better supplied with available plant food. With a few exceptions the same varieties were grown on each field. Those that were not common to both are omitted from Table 5.

The average yield of all varieties grown on Black Clay Loam On Clay was 20.3 bushels an acre, while the average yield of the varieties grown on Grayish Brown Silt Loam On Clay was 17.2 bushels an acre, a difference of 3.1 bushels. This amount does not seem great, considering the difference in the character of the two soils. When

TABLE 5.—ANALYTICAL DATA AND RESULTS OF MILLING AND BAKING TESTS OF VARIETIES OF WINTER WHEAT GROWN IN 1925 ON TWO VERY DIFFERENT TYPES OF SOIL IN CHRISTIAN COUNTY

Sample No.	Variety	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
		Uncleaned	Cleaned		Wheat	Flour							
	Grayish-Brown Silt Loam On Clay												
		lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
227	Minturki	59.2	61.2	72.2	10.45	9.23	.398	56.5	493	**1 930**	96	98	18.5
219	Fulcaster	58.0	60.0	70.4	10.37	8.90	.416	55.6	485	1 905	98	98	**20.4**
217	Michikof	59.8	62.3	68.8	10.80	9.87	.473	60.0	499	1 845	96	98	18.3
223	Workman Swamp	58.1	60.0	72.4	10.35	9.04	.420	57.3	488	1 810	96	50	16.2
229	Ohio 9920	56.0	58.6	71.1	10.29	9.04	.445	55.6	487	1 790	97	97	15.4
225	Blackhull	58.4	60.9	70.3	10.38	9.06	.457	58.2	496	1 785	96	96	16.2
221	Gladden	58.7	60.6	71.8	9.45	8.26	.394	54.7	485	1 755	97	94	18.8
218	Trumbull	57.1	59.0	70.5	**11.31**	9.88	.420	55.0	478	1 745	98	97	13.5
224	Ilred	59.1	61.4	71.6	10.19	9.29	.505	58.5	497	1 710	96	96	16.2
222	Fulhio	57.4	59.9	71.7	10.90	9.48	.390	55.6	483	1 675	96	94	17.8
226	Shepherd	56.5	58.8	70.3	10.11	8.64	.388	57.9	488	1 675	97	96	18.5
228	Kanred	58.4	61.0	74.3	10.05	8.77	.441	59.1	498	1 640	96	94	16.9
	Average	58.1	60.3	71.3	10.39	9.12	.429	57.0	489	1 772	96.6	92.3	17.2
	Black Clay Loam On Clay												
237	Ilred	58.6	60.9	70.9	12.59	11.63	.467	57.6	487	**2 080**	97	95	22.7
236	Minturki	58.7	60.9	73.5	12.37	10.84	.427	53.2	479	2 070	95	97	**28.1**
240	Michikof	59.0	61.6	71.8	13.76	12.73	.458	....	494	2 060	96	96	23.4
233	Fulhio	57.1	59.0	70.4	12.93	11.54	.473	57.4	484	2 035	97	98	17.1
243	Kanred	59.1	61.5	74.4	12.28	11.20	.467	57.1	488	2 010	97	98	24.5
232	Swamp	57.9	60.1	69.4	13.51	12.05	.515	56.8	487	1 985	97	97	20.9
239	Ohio 9920	55.6	58.5	69.2	**14.72**	12.94	.508	55.0	483	1 980	98	100	11.5
231	Trumbull	56.2	57.9	69.3	14.05	12.55	.481	56.8	488	1 940	97	90	20.8
235	Blackhull	58.4	61.2	73.3	13.50	11.22	.474	57.1	488	1 930	97	95	23.0
234	Fulcaster	57.2	59.4	69.5	14.29	12.05	.512	57.1	487	1 860	97	95	14.4
242	Gladden	56.3	58.9	70.6	12.49	11.16	.445	53.2	479	1 860	97	98	20.7
241	Shepherd	55.5	58.6	68.4	13.29	12.22	.460	55.0	488	1 700	97	94	17.1
	Average	57.5	59.9	70.9	13.31	11.84	.474	56.0	486	1 959	96.8	96.1	20.3

grown on Black Clay Loam On Clay the five hard varieties were the highest yielding. They ranged from 28.1 bushels an acre produced by Minturki to 22.7 bushels produced by Ilred. When grown on Grayish Brown Silt Loam On Clay, Fulcaster was the high-yielding wheat.

The most important fact shown by these data is that while there was no considerable difference in the average acre-yield of the wheat grown on the two types of soil, there was a great difference in the average quality of the grain produced. The protein content of the wheat grown on Grayish Brown Silt Loam On Clay was low, averaging 10.39 percent, while that grown on the heavier type of soil was high, averaging 13.31 percent. The average loaf volume of the varieties grown on the light soil was 1,772 cc.; of those grown on Black Clay Loam On Clay, 1,959 cc.

In this test (which was for one season only) Minturki and Fulcaster, grown on Grayish Brown Silt Loam On Clay, made flour of the best baking quality. When grown on Black Clay Loam On Clay most of the varieties made flour of fair to excellent strength. Ilred, Minturki, and Michikof were the ranking varieties and were of about equal strength. Shepherd made an inferior loaf in both cases.

QUALITY OF SOME FARM-GROWN WHEATS

Soft Wheats From Southern Illinois

It was considered advisable to supplement the study of wheat grown upon experimental plots by an investigation of the quality of the soft wheat being grown by farmers. Accordingly in 1925 samples of wheat consisting of several mature heads with straw attached, representing the crop, together with about four pounds of the threshed grain, were obtained from a number of farmers in certain of the southern counties of the state. The samples of heads and straw were used in an attempt to identify, so far as possible, the varieties being grown; the threshed grain was milled, and baking and chemical tests made.

Twenty-seven percent of the samples made loaves of good size; 73 percent produced loaves of medium or inferior size. Many of the latter had pale crusts, which were lumpy or split. The number of samples tested (62) and the number of counties represented (10), seems sufficient to give a fairly comprehensive and accurate idea of the character of the crop grown that year in the southern section of the state. A summary of the data pertaining to these samples is given in Table 6, the details in Table 18 of the Appendix.

The average protein content of all samples received from southern

Illinois farmers was 10.85 percent and the loaf volume was 1,841 cc. As nearly as could be determined from the specimens submitted for identification, 24 represented the Fultz variety, 8 the Fulcaster, while the remaining 30 samples represented 12 other varieties. The Fultz samples averaged 10.94 percent protein and 1,868 cc. loaf volume; the Fulcaster samples, 10.97 percent protein and 1,829 cc. loaf volume; the other 30 samples averaged 10.75 percent protein and 1,826 cc. loaf volume.

Altho there were hardly enough samples from some of the counties to justify a definite statement concerning the relative quality of the

TABLE 6.—WEIGHT PER BUSHEL, PERCENTAGE PROTEIN, AND LOAF VOLUME OF SAMPLES OF WHEAT RECEIVED FROM FARMERS IN SOUTHERN ILLINOIS
(Data summarized from Table 18 of the Appendix)

Varieties	Number of samples	Weight per bushel	Protein in wheat	Volume of loaves
		lbs.	*perct.*	*cc.*
Fultz	24	58.7	10.94	1 868
Fulcaster	8	57.9	10.97	1 829
Harvest Queen	5	59.4	11.32	1 916
Red Wave	5	58.2	10.24	1 703
Fulhio	3	59.5	11.70	1 953
Trumbull	3	58.7	10.24	1 812
Blackhull	2	58.7	12.14	1 852
Gladden	2	57.7	10.71	1 822
Mealy	2	57.8	9.61	1 607
Turkey Red	1	59.8	9.47	1 870
Red Clauson	1	57.9	11.03	1 860
Jones Fife	1	56.9	10.35	1 780
Shepherd	1	58.1	9.94	1 700
Unknown	2	58.2	10.70	1 922
Mediterranean	2	58.4	10.83	1 820
Average	62	58.5	10.85	1 841

wheat from each, it is interesting to note that there was great variation, as may be seen from Table 18 of the Appendix. The average protein content of 7 samples of wheat from Clay county was 12.49 percent and the average loaf volume 1,924 cc., while the average protein content of the 14 samples from Madison county was 10.15 percent and the loaf volume 1,775 cc. With the exception of the samples from Randolph county, progressive decrease in the average protein content of the wheat grown in the several counties was followed by progressive decrease in average loaf volume.

Hard, Soft, and Mixed Wheats From Central Illinois

Seventy-three samples of wheat representing carlots received from Illinois points at the terminal markets, St. Louis, and Indianapolis, in August 1925, were subjected to the quality tests already described. These samples represented 24 counties, chiefly those in central Illinois

TABLE 7.—SUMMARY OF ANALYTICAL DATA AND RESULTS OF MILLING AND BAKING TESTS ON SAMPLES OF WHEAT TAKEN FROM CARLOTS RECEIVED AT ST. LOUIS AND INDIANAPOLIS FROM SHIPPING POINTS IN CENTRAL ILLINOIS; SAME FOR 12 SAMPLES FROM INDIVIDUAL GROWERS IN CENTRAL SECTION OF ILLINOIS: CROP OF 1925

(Data summarized from Tables 19 and 20 of the Appendix)

Number of samples tested	Grade	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crust	Texture of crust
		Uncleaned	Cleaned		Wheat	Flour						
	(Samples from carlot shipments)	*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*
14	No. 1 hard winter	60.1	61.4	72.2	11.57	10.11	.449	55.1	483	1 827	95.9	96.6
22	No. 2 hard winter	59.1	60.7	71.1	11.21	9.70	.433	54.4	483	1 777	96.0	97.1
	Average	59.5	60.9	71.5	11.35	9.86	.439	54.7	483	1 797	95.9	96.9
1	No. 1 red winter	59.2	61.3	74.0	10.63	9.34	.460	53.2	477	1 880	95.0	95.0
16	No. 2 red winter	58.9	60.3	71.9	10.93	9.45	.394	53.1	475	1 798	96.9	97.0
1	No. 3 red winter	57.7	59.1	71.1	10.74	9.21	.420	52.1	474	1 700	96.0	97.0
	Average	58.9	60.3	72.0	10.90	9.43	.400	53.0	475	1 797	96.7	96.9
5	No. 1 mixed	59.4	60.9	70.6	11.06	9.42	.433	54.9	481	1 787	96.6	96.4
14	No. 2 mixed	59.0	60.4	70.7	11.33	9.73	.412	53.4	480	1 776	96.3	96.9
	Average	59.1	60.5	70.7	11.26	9.65	.418	53.8	481	1 779	96.4	96.8
	(Samples from individual growers)											
12	Miscellaneous	60.8	62.3	73.6	11.33	10.17	.517	53.8	481	1 860	96.6	97.3

lying east of the Illinois river. From 11 of these counties came samples of both hard and of soft wheats or samples composed of a mixture of these two classes. It is practically certain that both classes of wheat are grown in all the counties of the central section of Illinois. The growing of both classes of wheat in the same community inevitably leads to more or less serious mixing.

A summary showing the average data for the several classes and grades is presented in Table 7. The detailed data pertaining to these samples have been grouped in Table 19 of the Appendix according to the class and grade reported by the inspector. At the time they were milled, the test weight determined in the Experiment Station laboratory would have thrown a number of the samples into a lower grade.

No marked differences existed in the average composition of the three classes of wheat represented in these tests, nor in the strength of the flour. In percentage of flour the 14 samples of No. 1 hard red winter averaged slightly higher than any of the other grades except the one sample of No. 1 red winter. They also averaged slightly higher in protein content and, except for the one sample of No. 1 soft red winter wheat, produced the greatest average loaf volume. The average protein content of the 36 hard-wheat samples, including both No. 1 and No. 2 grades, was 11.35 percent; the loaf volume was 1,797 cc.

The average protein content of the 18 soft-wheat samples was 10.90 percent, which is .45 percent less than the hard-wheat samples. The average loaf volume of the soft-wheat samples was 1,797 cc., which volume equaled that of the hard-wheat samples. In this connection it should be noted that the average protein content of the soft-wheat samples submitted by growers in the southern section of the state was 10.85 percent and the average loaf volume was 1,841 cc. (Table 6).

The 19 samples of mixed wheat contained an average of 11.26 percent protein and made an average loaf volume of 1,779 cc. The average protein content was .09 percent less than that of the hard wheat, while the loaf volume was 18 cc. less than that of either the hard or the soft wheats.

In addition to the 73 samples representing carlots, 12 samples were secured from individual growers in the central and northern sections. Nine of these samples were hard red winter wheats, one was a soft red winter wheat, one a hard red spring wheat, while the class of one sample was unrecorded but was doubtless a hard winter wheat. The

data concerning these samples are given in Table 7 and Appendix Table 20. The average protein content of these 12 samples (Table 7) was practically the same as that of the 36 samples of hard wheat representing carlots shipped from Illinois points; the average loaf volume was somewhat greater than that of the samples representing carlots. Five of the 12 samples made loaves of good volume; the other 7 samples produced loaves that were medium to inferior in size.

QUALITY OF SPRING WHEAT GROWN ON TWO EXPERIMENT FIELDS IN ILLINOIS

Spring wheat is grown to a limited extent in Illinois. Most of it is produced in the northern third of the state. It has been grown with a considerable degree of success for a number of years on the Experiment Station field at DeKalb, in the northern part of the state, and at Urbana, in the central section.

Environmental conditions in the premier hard spring-wheat states —Minnesota, the Dakotas, and Wyoming—are conducive to the production of wheat which mills into flour of excellent strength. It is a matter of considerable interest to learn whether spring wheat grown under Illinois conditions will produce flour well suited for making yeast-lightened bread; also, how the different varieties compare in quality of the flour.

Under the conditions which prevailed at Urbana, Kota and White Australian made superior flour for yeast bread. Of four varieties of spring wheat grown at Urbana during the three-year period 1924-1926, Illinois No. 1 ranked first in average yield of grain, Marquis second, White Australian third, and Kota fourth (Table 8). The quality of the flour, as measured by the loaf volume, was exactly in the reverse order. Kota made loaves of excellent size and quality. Illinois No. 1 made loaves of medium to inferior size and, except in 1924, of inferior quality. Each of these four varieties of wheat averaged high in protein content. Marquis, which averaged the lowest, contained 13.26 percent of protein; while Kota, the highest, averaged 14.45 percent. Kota made an average loaf volume of 2,035 cc., while Illinois No. 1 produced an average of only 1,783 cc.

At DeKalb Marquis produced flour of the greatest average strength during the three-year period 1924-1926. Kota did well in 1924 and 1925 but failed in 1926, doubtless because of scab infection and damage by wet weather. The average protein content of all samples from DeKalb was 13.03 percent and the loaf volume 1,926 cc. (Table 21, Appendix).

TABLE 8.—COMPARATIVE MILLING AND BAKING QUALITIES OF VARIETIES OF SPRING WHEAT GROWN ON EXPERIMENT FIELDS AT URBANA, CHAMPAIGN COUNTY, AND AT DEKALB, DEKALB COUNTY

(Data summarized from Table 21 of the Appendix)

Variety	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
	Uncleaned	Cleaned		Wheat	Flour							
Urbana experiment field												
1924, '25, '26	*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
Kota	61.5	63.7	73.4	**14.45**	13.10	.510	57.9	491	**2 035**	97.3	99.3	27.3
White Australian	60.1	62.0	76.1	13.52	12.16	.582	51.5	472	1 932	98.3	99.3	30.5
Marquis	60.1	62.6	75.0	13.26	12.04	.536	55.3	489	1 813	96.7	97.7	31.8
Illinois No. 1	61.0	62.8	72.6	13.61	12.33	.499	54.2	486	1 783	97.0	96.6	**33.0**
1924, '25												
Kota	61.2	63.8	71.8	14.17	12.90	.508	60.5	497	2 030	98	99	26.9
White Australian	60.4	62.5	76.0	13.24	11.98	.622	52.1	474	1 915	98.5	100	31.3
Illinois No. 1	60.7	62.6	72.7	14.40	13.13	.504	56.5	...	1 778	97.5	97.5	32.1
Marquis	59.8	62.7	75.2	13.03	11.86	.536	57.7	495	1 770	97	98	30.5
Wisconsin Wonder	61.0	63.7	73.7	15.18	13.68	.500	55.3	481	1 767	97	93	23.8
Blue Ribbon	61.9	63.8	72.2	13.53	12.05	.498	56.3	494	1 720	97	97.5	27.9
1926												
Kota	61.9	63.4	76.7	14.99	13.49	.515	52.9	478	2 045	96	100	28.1
White Australian	59.4	60.9	76.4	14.08	12.52	.501	50.3	470	1 965	98	98	29.0
Progress	62.7	63.7	74.6	13.27	11.25	.469	50.9	476	1 965	98	98	33.1
Marquis	60.7	62.3	74.5	13.71	12.39	.535	50.6	476	1 900	96	97	34.4
Dicklow	52.4	54.4	72.4	9.96	8.81	.597	50.3	473	1 820	97	97	19.5
Illinois No. 1	61.6	63.2	72.4	12.02	10.71	.488	49.7	475	1 795	96	95	34.7
Garnet	61.8	63.5	76.8	11.42	10.39	.576	52.9	484	1 615	95	95	....
DeKalb experiment field												
1924, '25, '26												
Marquis	55.0	58.6	70.9	12.64	11.48	.510	55.5	478	**2 072**	97	98	27.5
Kota	54.2	59.1	72.8	**14.12**	.....	.565	55.6	480	1 840	94	92	24.6
Illinois No. 1	56.8	60.4	71.2	12.71	11.68	.473	52.6	477	1 823	96	92	**29.5**
1924												
Marquis	55.9	59.9	72.5	12.54	11.20	.505	55.3	475	2 245	99	100	30.7
Kota	52.0	59.2	71.9	14.76	12.69	.650	55.3	471	2 110	94	95	27.5
Blue Ribbon	55.9	60.5	73.7	12.84	11.03	.457	....	467	1 970	95	85	28.8
Illinois No. 1	55.4	59.9	71.0	13.18	11.96	.525	51.8	469	1 910	95	90	30.5
1925												
Marquis	56.8	59.2	70.0	14.04	13.06	.545	60.3	492	2 090	96	96	27.2
Wisconsin Wonder	58.4	61.5	72.8	15.36	14.63	.543	56.5	488	2 010	97	100	23.6
Kota	57.2	59.7	72.4	14.61	.....	.595	58.5	495	2 000	97	101	25.4
Illinois No. 1	59.5	61.9	69.9	13.86	13.09	.503	55.9	488	1 760	96	90	34.1
1926												
White Australian	51.0	55.1	76.1	11.61	10.66	.400	52.4	...	2 030	92	92	22.6
Marquis	52.2	56.8	70.3	11.34	10.19	.480	50.9	467	1 880	96	98	24.5
Progress	58.9	....	73.9	11.14	10.39	.400	48.8	463	1 820	97	98	28.2
Illinois No. 1	55.6	59.3	72.7	11.10	10.00	.390	50.0	473	1 800	97	96	23.9
Kota	53.5	58.3	74.0	12.99	11.71	.450	52.9	474	1 410	90	80	20.8

EFFECT OF ENVIRONMENT ON QUALITY OF WHEAT

Comparison of Protein Content and Loaf Volume of Wheats Grown at Urbana, DeKalb, and Alhambra

Environment, which may include the natural physical and chemical composition of the soil, its management with respect to drainage,

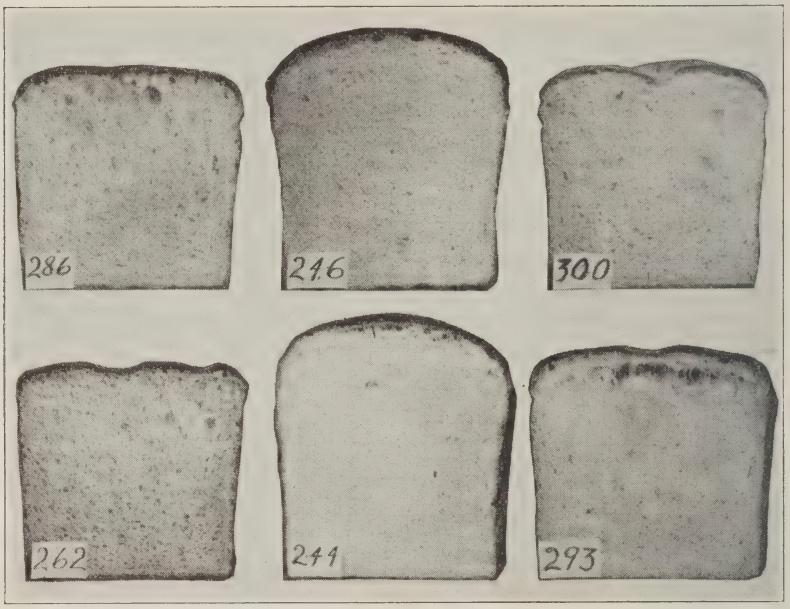

FIG. 1.—BREAD MADE FROM ILRED AND BLACKHULL GROWN AT URBANA, DEKALB, AND ALHAMBRA, 1925

The same variety of wheat, grown in different environments, may produce flours that vary greatly in baking strength. *Above, Ilred*—Sample 286, Urbana, 1,750 cc. loaf volume; Sample 246, DeKalb, 2,090 cc.; Sample 300, Alhambra, 1,755 cc. *Below, Blackhull*—Sample 262, Urbana, 1,700 cc.; Sample 244, DeKalb, 2,080 cc.; Sample 293, Alhambra, 1,685 cc.

tillage, fertilization and cropping practices, as well as climatic conditions, has a marked effect upon the protein content of wheat and the baking strength of the flour.

Comparison of Urbana and DeKalb Wheats.—During the four years 1923 to 1926, the average protein content of 44 samples of wheat grown at DeKalb was 11.10 percent, while the same varieties on the Urbana field averaged 12.44 percent (Table 9). Notwithstanding this fact, the Urbana grown wheat averaged 1,812 cc. in loaf volume as compared with 1,978 cc. made by the DeKalb wheat.

TABLE 9.—AVERAGE PROTEIN CONTENT AND AVERAGE LOAF VOLUME OF THE SAME VARIETIES OF WINTER WHEAT GROWN AT DEKALB AND AT URBANA

Year	DeKalb		Urbana		Number of varieties
	Crude protein in wheat	Volume of loaf	Crude protein in wheat	Volume of loaf	
	perct.	*cc.*	*perct.*	*cc.*	
1923	12.71	2 012	13.28	1 826	8
1924	9.99	1 963	11.62	1 711	11
1925	10.91	1 952	12.77	1 765	12
1926	11.24	1 992	12.31	1 938	13
Average	11.10	1 978	12.44	1 812	(44 samples)

Comparison of Urbana and Alhambra Wheats.—The average percentage of protein and the average loaf volume of those varieties of wheat grown in common on the Urbana and Alhambra fields during the years 1922, 1923, 1925, and 1926 are shown in Table 10.

There was little difference in the protein content of the wheat grown on the two fields in 1922 and 1923. In 1925 and 1926 the Urbana wheat exceeded the Alhambra wheat 3.17 and 1.86 per-

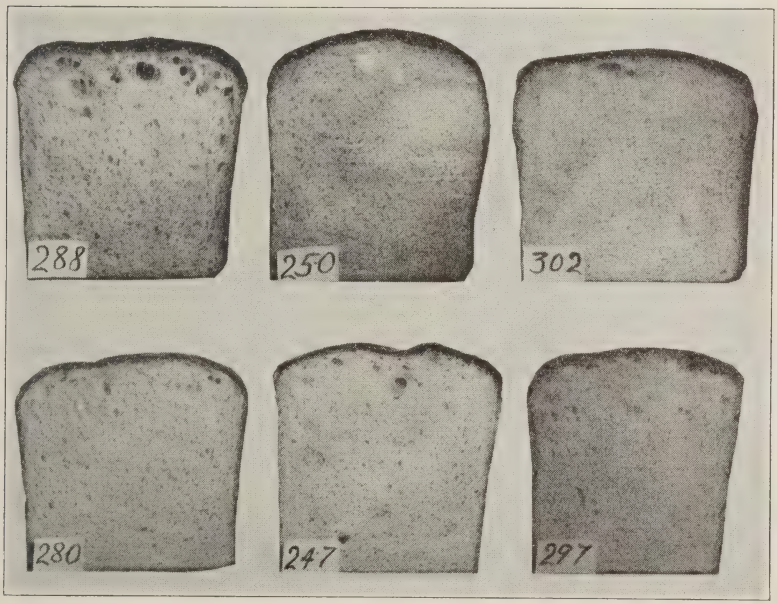

FIG. 2.—BREAD MADE FROM TRUMBULL AND FULHIO GROWN AT URBANA, DEKALB, AND ALHAMBRA, 1925

Above, Trumbull—Sample 288, Urbana, 1,805 cc. loaf volume; Sample 250, DeKalb, 1,970 cc.; Sample 302, Alhambra, 1,765 cc. *Below, Fulhio*—Sample 280, Urbana, 1,630 cc.; Sample 247, DeKalb, 1,860 cc.; Sample 297, Alhambra, 1,740 cc.

TABLE 10.—AVERAGE PROTEIN CONTENT AND AVERAGE LOAF VOLUME OF THE SAME VARIETIES OF WINTER WHEAT GROWN AT URBANA AND AT ALHAMBRA

Year	Urbana		Alhambra		Number of varieties
	Crude protein in wheat	Volume of loaf	Crude protein in wheat	Volume of loaf	
	perct.	*cc.*	*perct.*	*cc.*	
1922	9.91	1 502	9.72	1 482	3
1923	13.32	1 727	13.58	1 975	3
1925	12.65	1 699	9.48	1 735	7
1926	12.36	1 853	10.50	1 755	6
Average	12.23	1 721	10.49	1 739	(19 samples

cent respectively. The Urbana wheat exceeded the Alhambra wheat in average loaf volume in 1922 and 1926 while the Alhambra wheat exceeded the Urbana wheat in 1923 and 1925. The average protein content of the Urbana wheat during the four-year test was 12.23 percent, while the average protein content of the same varieties produced at Alhambra was 10.49 percent. Notwithstanding this difference of 1.74 percent protein in favor of the Urbana wheat, the Alham-

FIG. 3.—BREAD MADE FROM MINNESOTA RELIABLE AND KANRED GROWN AT URBANA AND DEKALB, 1925

Above, Minnesota Reliable—Sample 287, Urbana, 1,945 cc. loaf volume; Sample 254, DeKalb, 1,990 cc. *Below, Kanred*—Sample 264, Urbana, 1,700 cc.; Sample 253, DeKalb, 1,880 cc.

bra wheat produced an average loaf volume of 1,739 cc. as compared with 1,721 cc. made by the Urbana wheat.

Does Hard Winter Wheat Deteriorate Under Illinois Conditions?

The statement is frequently made that hard wheat grown in a region favorable for the production of high-protein wheat capable of making strong flour, will, when grown under conditions such as prevail in Illinois, gradually deteriorate, becoming softer and lower in protein content with each successive crop.

In Table 11 is shown the milling and baking values of certain lots of seed obtained from other states and of the crops grown from such seed under Illinois conditions; also of succeeding generations where more than one crop was grown. Four of these lots of seed for which milling and baking data are available were hard varieties from the hard wheat section of Kansas. The others were both hard and soft varieties and came from such widely separated regions as Minnesota, Michigan, Missouri, New York, and Ohio.

The data afforded by this investigation, tho limited in extent, hardly bear out the impression suggested above. Successive crops of hard red winter wheat grown from seed brought in from hard-wheat regions, it will be noted, did not progressively deteriorate. In some cases the first crop grown in Illinois was decidedly inferior in baking quality to the imported seed, but subsequent crops showed, in some cases, considerable improvement over the first, depending upon seasonal conditions.

The data pertaining to the Kansas grown wheat are of particular interest. Altara 2048, grown in Kansas in 1923, contained 11.18 percent protein and made a loaf volume of 1,885 cc. The amount of protein and the size of the loaf were only moderate. The first crop grown from the Kansas seed contained 11.06 percent protein; the loaf volume was only 1,530 cc. Thus the first generation grown in Illinois was only .12 percent lower in protein than the parent stock, but the flour was much inferior in baking strength. The second generation contained 1.63 percent more protein than did the Kansas grown seed, yet the baking strength was less. The third generation grown contained 1.08 percent more protein than the original seed and the quality of the flour as indicated by loaf volume and texture was about equal to the original seed.

Kanred 2401, secured from the same source the same year as Altara 2048, contained 11.88 percent protein and produced a loaf of

TABLE 11.—COMPARISON OF QUALITY OF WINTER WHEAT GROWN IN OTHER STATES AND THAT PRODUCED FROM SAME SEED AT URBANA

Year	Where grown	Source of seed	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb
			Uncleaned	Cleaned		Wheat	Flour						
Altara 2048			*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*
1923	Kansas	Kansas	....	....	70.5	11.18	9.52	....	52.1	475	1 885	97	96
1924	Urbana	Kansas	62.0	64.4	77.2	11.06	10.02	.417	55.0	485	1 530	97	96
1925	Urbana	Urbana	61.5	64.2	73.3	12.81	10.50	.451	60.0	500	1 750	96	97
1926	Urbana	Urbana	60.8	62.8	75.8	12.26	11.28	.528	52.9	479	1 870	96	97
Kanred 2401													
1923	Kansas	Kansas	....	....	70.3	11.88	10.34	....	50.6	467	1 980	97	96
1924	Urbana	Kansas	59.3	62.1	76.1	10.75	9.36	.368	52.4	478	1 755	96	94
1926	Urbana	Urbana	60.7	62.5	75.7	11.89	11.24	.491	51.2	478	1 810	97	97
Kanred (cert.)													
1925	Kansas	Kansas	57.9	59.8	72.0	11.94	10.77	.625	55.9	488	1 865	95	97
1926	Urbana	Kansas	60.3	62.5	76.9	13.20	11.11	.482	51.8	476	1 805	97	98
Turkey Red (cert.)													
1925	Kansas	Kansas	57.0	59.3	70.6	12.28	11.42	.620	57.7	490	1 985	95	98
1926	Urbana	Kansas	60.3	62.5	74.4	12.53	11.39	.428	52.6	475	1 920	97	101
Minturki													
1923	Minnesota	Minnesota	....	....	68.0	12.56	10.86	.385	47.1	459	2 020	96	95
1924	Urbana	Minnesota	61.2	63.0	74.5	11.79	10.28	.355	50.6	474	1 982	96	97
1925	Urbana	Urbana	60.6	62.3	73.8	12.37	11.31	.456	56.6	493	1 460	95	90
1926	Urbana	Urbana	60.0	62.0	77.4	12.16	11.19	.461	50.9	465	2 080	97	100
Fulcaster													
1923	Missouri	Missouri	....	....	72.9	10.34	8.91	....	49.4	461	2 130	..	..
1924	Urbana	Missouri	58.5	61.3	71.8	10.86	9.48	.436	52.9	481	1 590	97	96
1925	Urbana	Urbana	60.5	62.0	69.3	12.73	10.96	.503	57.0	490	1 710	96	97
Poole													
1923	Missouri	Missouri	....	....	66.9	11.12	9.68	....	49.7	468	1 945	99	100
1924	Urbana	Missouri	58.9	60.8	73.1	11.59	9.98	.484	52.1	477	1 550	97	96
Berkeley Rock													
1923	Michigan	Michigan	....	....	69.3	14.13	11.50	....	49.7	464	1 960	99	97
1924	Urbana	Michigan	55.5	59.5	76.3	12.51	10.91	.547	55.0	489	1 570	98	98
1925	Urbana	Urbana	59.3	62.5	71.9	13.36	12.18	.546	57.9	487	1 780	96	97
1926	Urbana	Urbana	58.8	60.8	73.3	13.72	12.98	.543	52.1	477	1 955	97	99
Honor													
1924	New York	New York	56.4	58.4	71.2	9.03	8.09	.508	48.2	465	1 565	96	90
1925	Urbana	New York	58.2	60.8	75.0	12.07	10.74	.470	55.0	486	1 540	97	93
1926	Urbana	Urbana	56.0	58.6	72.8	11.51	9.96	.568	50.3	471	1 610	95	90
Trumbull													
1925	Ohio	Ohio	61.8	62.8	70.9	11.53	9.60	.448	54.7	482	2 105	99	101
1926	Urbana	Ohio	57.8	60.0	72.1	12.82	11.59	.331	51.8	483	1 940	97	97
Fulhio													
1925	Ohio	Ohio	59.0	60.2	71.4	10.82	9.74	.514	55.9	484	1 990	98	99
1926	Urbana	Ohio	58.8	60.7	76.2	12.64	11.33	.454	51.8	477	1 730	95	95

FIG. 4.—BAKING STRENGTH OF FLOUR MILLED FROM KANSAS GROWN HARD RED WINTER WHEAT COMPARED WITH THAT FROM SUCCESSIVE GENERATIONS GROWN AT URBANA

Above, Altara 2048—Sample 6, grown in Kansas in 1923; Sample 41, first generation grown at Urbana in 1924; Sample 275, second generation, 1925; Sample 424, third generation, 1926. *Below, Kanred 2401*—Sample 4, grown in Kansas in 1923; Sample 18, first generation grown at Urbana in 1924; Sample 426, third generation, 1926.

1,980 cc. volume. The crop grown in Illinois in 1924 contained 1.13 percent less protein, and the size and quality of the loaf was correspondingly inferior. No milling and baking data are available for the 1925 crop. The third generation, produced in 1926, contained as much protein as the Kansas grown seed; nevertheless the strength of the flour was less.

In 1925 certified Kanred seed was secured from Kansas. This analyzed 11.94 percent protein and made a loaf volume of 1,865 cc. The crop produced from this in 1926 contained 13.20 percent protein. The volume of the loaf was 1,805 cc. Certified Turkey Red, obtained at the same time from the same source, contained 12.28 percent protein and made a large loaf of good texture. The crop grown from this seed contained 12.53 percent protein and made a loaf nearly as great in volume as the original seed and of even better quality.

A summary of the data pertaining to all varieties of winter wheat, both hard and soft, used in this investigation is given below:

Seed	Number of varieties	Protein content	Loaf volume
		perct.	*cc.*
Original seed	11	11.53	1,948
First generation	11	11.90	1,719
Original seed	5	11.46	1,912
Second generation	5	12.56	1,662
Original seed	4	12.44	1,961
Third generation	4	12.50	1,929

It will be observed that each generation of Illinois grown wheat exceeded the original seed in average protein content but that the average loaf volume was less. This difference in loaf volume was not great in the third generation, but it is to be observed that conditions were favorable on the Urbana field in 1926 for the production of unusually strong flour. (Note loaf volumes in Table 14, Appendix).

What Is Effect on Northern-Grown Spring Wheat Sown in Illinois?

In the spring of 1925 a quantity of Kota and Marquis spring wheat was obtained from the North Dakota Experiment Station. Kota tested 64.2 pounds to the bushel and would probably have graded No. 1 dark northern spring. Marquis tested 61.5 pounds to the bushel but would not have graded dark northern. Sufficient seed of each variety was secured to sow in the variety trials at Urbana and DeKalb in 1925 and 1926. Since the crops in both seasons were produced from the same original stock of seed grown in North Dakota, any differences in composition or baking strength of the flour may be attributed to

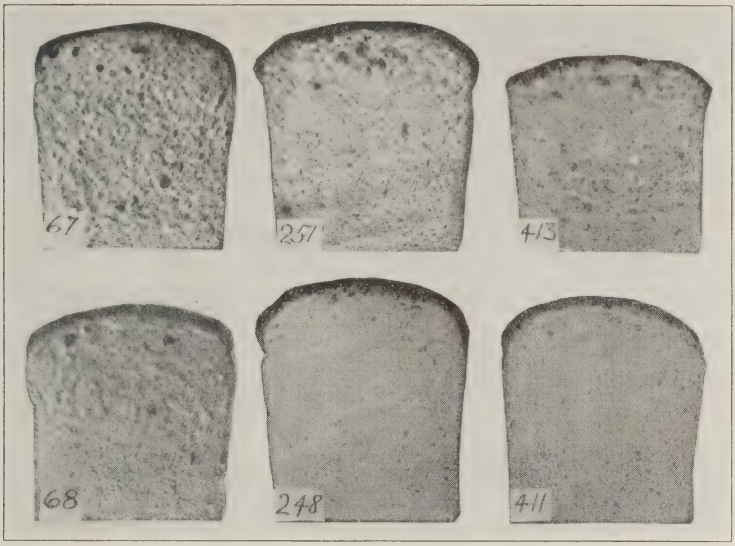

FIG. 5.—BAKING STRENGTH OF FLOUR MILLED FROM NORTH DAKOTA GROWN HARD RED SPRING WHEAT COMPARED WITH THAT OF CROPS GROWN AT DEKALB FROM SAME WHEAT

Above, Kota—Sample 67, grown in North Dakota, 1,960 cc. loaf volume; Sample 251, grown at DeKalb in 1925 from Dakota seed, 2,065 cc.; Sample 413, grown in 1926 at DeKalb from same Dakota seed, 1,700 cc. *Below, Marquis*—Sample 68, grown in North Dakota, 1,810 cc. loaf volume; Sample 248, grown at DeKalb in 1925 from Dakota seed, 2,215 cc.; Sample 411, grown in 1926 from same Dakota seed, 1,980 cc.

factors other than the seed. The data relating to this experiment are presented in Table 12.

It will be noted that Illinois grown wheat may equal or even excel northern-grown seed in protein content and loaf volume. Marquis seed secured from North Dakota tested only 10.65 percent protein, and the loaf volume was 1,795 cc. The crop grown from it at Urbana in 1925 tested 13.36 percent protein and produced a large loaf (1,990 cc.) of good quality. The crop of 1926 was over 2 percent lower in protein content than that of the previous year. Even then it slightly exceeded the original seed, while the quality of the flour, as indicated by the loaf volume and texture, was considerably superior. The crop grown at DeKalb in 1925 contained 13.54 percent protein, while the loaf volume was 2,215 cc. and the texture of crumb graded 101. In 1926 the protein content was 10.76 percent, only .11 percent greater than that of the Dakota grown seed. The loaf volume was 1,980 cc. and the texture was slightly superior to the original seed.

TABLE 12.—COMPARISON OF QUALITY OF NORTHERN-GROWN SPRING WHEAT AND WHEAT GROWN FROM SAME SEED AT URBANA AND DEKALB

Year	Where grown	Source of seed	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb
			Uncleaned	Cleaned		Wheat	Flour						
Urbana experiment field													
			lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*
Marquis													
1924	No. Dakota	No. Dakota	61.5	62.6	74.0	10.65	9.70	.504	56.1	486	1 795	97	96.5
1925	Urbana	No. Dakota	61.5	62.8	72.7	13.36	12.46	.505	59.1	496	1 990	98	97
1926	Urbana	No. Dakota	61.3	62.7	75.3	11.17	10.39	.577	50.6	456	1 900	97	98
Kota													
1924	No. Dakota	No. Dakota	64.2	65.0	76.9	12.38	.....	.541	56.8	483	2 125	97	99.5
1925	Urbana	No. Dakota	62.4	63.9	71.6	14.47	13.48	.672	60.6	505	1 985	97	100
1926	Urbana	No. Dakota	62.7	64.4	77.0	11.65	10.67	.573	52.9	479	1 810	96	98
Progress													
1925	Wisconsin	Wisconsin	62.8	63.3	72.6	14.29	12.93	.431	57.3	485	2 050	99	100
1926	Urbana	Wisconsin	62.7	63.7	74.6	13.27	11.25	.469	50.9	476	1 965	98	98
Dicklow													
1925	Idaho	Idaho	57.1	58.0	72.3	9.07	7.63	.471	59.7	479	1 805	98	99
1926	Urbana	Idaho	52.4	54.4	72.4	9.96	8.81	.597	50.3	473	1 820	97	97
DeKalb experiment field													
Marquis													
1924	No. Dakota	No. Dakota	61.5	62.6	74.0	10.65	9.70	.504	56.1	486	1 795	97	96.5
1925	DeKalb	No. Dakota	57.1	59.4	70.8	13.54	12.80	.570	56.5	486	2 215	98	101
1926	DeKalb	No. Dakota	52.3	56.1	73.3	10.76	9.79	.440	51.2	470	1 980	96	97
Kota													
1924	No. Dakota	No. Dakota	64.2	65.0	76.9	12.38	.....	.541	56.8	483	2 125	97	99.5
1925	DeKalb	No. Dakota	57.9	60.6	71.2	14.33	.....	.617	58.5	489	2 065	95	94
1926	DeKalb	No. Dakota	55.7	59.9	76.2	12.98	12.14	.410	54.4	485	1 700	91	90

The North Dakota grown Kota wheat tested 12.38 percent protein. It made a large loaf of excellent quality, which measured 2,125 cc. in volume and scored 99.5 in texture. The crops grown at Urbana in 1925 and 1926 tested 14.47 and 11.65 percent protein respectively. The 1925 crop produced flour of excellent strength, while that of the 1926

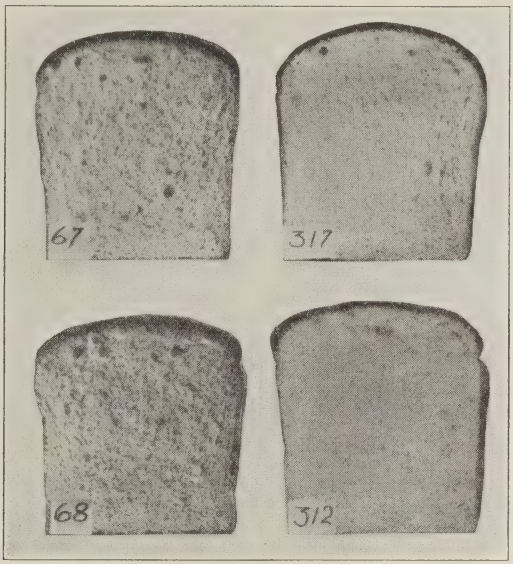

FIG. 6.—BAKING STRENGTH OF FLOUR MILLED FROM NORTH DAKOTA GROWN HARD RED SPRING WHEAT COMPARED WITH THAT OF CROPS GROWN AT URBANA FROM SAME WHEAT

Above, Kota—Sample 67, grown in North Dakota, 1,960 cc. loaf volume; Sample 317, grown at Urbana in 1925 from Dakota seed, 1,985 cc. *Below, Marquis*—Sample 68, grown in North Dakota, 1,810 cc.; Sample 312, grown at Urbana in 1925 from Dakota seed, 1,990 cc.

crop was medium in strength. The 1925 crop produced at DeKalb contained 14.33 percent protein. It produced a loaf of 2,065 cc. volume but of rather inferior quality. The fact that the protein content of the 1926 crop was .60 percent greater than the original seed, yet the quality of the flour very inferior, may be attributed in part at least to damage by wet weather after the wheat was in the shock.

The average protein content of the Dakota grown Marquis and Kota was 11.51 percent, and the average volume of loaf of the flour from them was 1,960 cc. The crops grown from these two varieties at DeKalb averaged 12.90 percent protein and 1,990 cc. loaf volume.

Progress grown in Wisconsin in 1925 tested 14.29 percent protein as compared with 13.27 percent in the crop grown in 1926 at Urbana. The loaf volume of the Wisconsin seed was 2,050 cc., while that of the Urbana crop was 1,965 cc.

Dicklow is a soft white spring wheat. The sample used in this experiment was grown in Idaho under irrigation. As might be expected, the Idaho grown wheat was low in protein content (9.07 percent). It made a medium-sized loaf of good quality. The Urbana grown crop contained 9.96 percent protein. It also produced a loaf of medium size but of scarcely as good quality as that made from the Idaho grown wheat.

The average protein content of the imported seed, all varieties, was 11.60 percent, while the average protein content of the crops grown at Urbana was 12.31 percent. The average loaf volume of the imported seed was 1,944 cc. compared with an average volume of 1,911 cc. produced by the Urbana grown crops.

COMPARISON OF HARD AND SOFT WHEATS AS TO PROTEIN CONTENT AND LOAF VOLUME

Some interesting facts relative to the protein content and baking strength of hard and soft wheats are shown in Table 13, which is a summary of the detailed data presented in the preceding tables.

Thirty-four samples of hard wheat grown on the DeKalb field during the period 1923-1926 had an average protein content of 11.15 percent, while 11 samples of soft wheat averaged 10.84 percent, which is a difference of only .31 percent. The 34 samples of hard wheat made an average loaf volume of 1,996 cc.; while the 11 soft samples averaged 1,914 cc., or 82 cc. less than the hard wheat.

At Urbana 61 samples of hard wheat grown during 1922-1926 averaged 12.15 percent protein; 43 samples of soft wheat averaged 11.90 percent, a difference of only .25 percent. Notwithstanding this small difference in composition, the hard wheat averaged 1,814 cc. loaf volume, while the soft wheat averaged 1,698 cc. There was a difference of 116 cc. in average loaf volume in favor of the hard wheat.

Eight samples of hard wheat grown at Alhambra during the years 1922, 1923, 1925, and 1926 averaged 10.71 percent protein; while 35 samples of soft wheat averaged 10.75 percent. The hard wheat made an average loaf volume of 1,741 cc. and the soft wheat an average loaf volume of 1,767 cc. In this case the soft wheat slightly exceeded the hard wheat both in protein content and in loaf volume.

TABLE 13.—COMPARISON OF QUALITY OF HARD AND SOFT RED WINTER WHEAT GROWN ON EXPERIMENTAL PLOTS AND ALSO OF CARLOTS RECEIVED AT ST. LOUIS AND INDIANAPOLIS

Year	Hard wheat			Soft wheat		
	Number of samples	Crude protein in wheat	Volume of loaf	Number of samples	Crude protein in wheat	Volume of loaf
Urbana experiment field						
		perct.	*cc.*		*perct.*	*cc.*
1922	7	9.90	1 739	6	9.70	1 665
1923	11	13.43	1 800	6	12.97	1 789
1924	14	11.47	1 739	11	11.35	1 578
1925	13	12.68	1 755	11	12.64	1 699
1926	16	12.42	1 972	9	12.41	1 805
Average	(61)	12.15	1 814	43	11.90	1 698
DeKalb experiment field						
1923	7	12.75	2 027	1	12.41	1 800
1924	9	9.93	1 986	3	10.08	1 878
1925	9	10.89	1 949	3	10.99	1 963
1926	9	11.39	2 019	4	10.91	1 931
Average	(34)	11.15	1 996	11	10.84	1 914
Alhambra experiment field						
1922	2	9.89	1 542	9	9.88	1 747
1923	2	13.79	1 945	9	12.35	1 777
1925	2	9.17	1 720	8	9.67	1 775
1926	2	9.99	1 755	9	10.98	1 772
Average	(8)	10.71	1 741	35	10.75	1 767
Hand-planted plots on different soil types						
1926	12	11.59	1 609	48	11.85	1 593
Christian county: Grayish Brown Silt Loam On Clay						
1926	5	10.37	1 782	7	10.40	1 765
Christian county: Black Clay Loam On Clay						
1926	5	12.90	2 030	7	13.61	1 909
Carlots received at St. Louis and Indianapolis						
1925	36	11.35	1 797	18	10.90	1 797
Grand average	(161)	11.61	1 835	169	11.48	1 718

Twelve lots of hard wheat (Ilred) grown on different types of soil in a number of counties of the southern part of the state averaged 11.59 percent protein; while 48 lots of soft wheat grown under comparable conditions contained an average of 11.85 percent protein. The hard wheat made an average loaf volume of 1,609 cc. and the soft wheat 1,593 cc.

Five varieties of hard wheat grown on Grayish Brown Silt Loam in Christian county averaged 10.37 percent protein; while 7 varieties of soft wheat averaged 10.40 percent. The hard wheat made an average loaf volume of 1,782 cc. and the soft varieties 1,765 cc. The same hard varieties grown on Black Clay Loam On Clay in Christian county averaged 12.90 percent protein, while the soft wheats averaged 13.61

percent. The average loaf volume was 2,030 cc. and 1,909 cc. respectively. Thus there was a difference of .71 percent protein in favor of the soft wheats and 121 cc. loaf volume in favor of the hard wheats.

In all these variety experiments the different kinds of wheat were grown under as nearly comparable conditions as the unavoidable differences in soil would permit. Except in the case of the wheat grown on Black Clay Loam On Clay in the Christian county variety tests the two classes of wheat were, in each of the several cases, of nearly equal average protein content. In every instance except one the hard varieties made an average loaf volume somewhat greater than did the soft varieties. With this exception they exceeded the soft varieties by as little as 16 cc. to as much as 121 cc.

The samples of hard and of soft wheat representing carlots received at Indianapolis and St. Louis came from a number of counties located chiefly in the central section of the state. Their places of origin were, however, widely scattered, so that environmental conditions must necessarily have differed considerably. Nevertheless there was no great difference in the average protein content of the two classes of wheat. The average protein content of the 36 samples of hard wheat was 11.35 percent, as compared with 10.90 percent, the average protein content of 18 samples of soft wheat. The average loaf volume of the hard wheat was 1,797 cc., while that of the soft wheat was also 1,797 cc.

A summary of all the data (Table 13) shows that 161 samples of hard wheat contained an average of 11.61 percent protein and made an average loaf volume of 1,835 cc. Compared with this, 169 samples of soft wheat had an average protein content of 11.48 percent and made an average loaf volume of 1,718 cc. Thus there was a difference of only .13 percent protein between the two classes in favor of the hard wheat. The hard wheat made stronger flour, however, as indicated by the larger average size of loaf, which exceeded that of the soft wheat by 117 cc.

SUMMARY

The composition and the milling and baking quality of many varieties of wheat grown on experimental plots in the northern, central, and southern sections of Illinois under conditions as nearly comparable as possible, were tested over a period of five years (1922-1926). Tests were also made of some samples of farm-grown wheat. The results are briefly summarized in the following paragraphs.

Quality of Varieties Grown on Experiment Fields.—Of the hard varieties grown on the experiment field at Urbana, Minnesota Reliable

and Michikof most consistently produced loaves of good size and texture. Many of the other hard varieties made flour of inferior strength. None of the soft varieties grown for three or more years averaged better than medium in strength.

Most of the samples from the variety plots at DeKalb, in the northern part of the state, produced strong flour. Minnesota Reliable most consistently made loaves of large size and excellent quality. Blackhull, also, when grown on this field, made an excellent record in marked contrast to the Blackhull samples grown at Urbana, where only the crop of 1926 yielded strong flour.

Wheat grown on the DeKalb field averaged considerably lower in protein content than did the same varieties produced on the Urbana field; nevertheless, the DeKalb wheat was decidedly superior in baking quality.

No one variety grown on the experiment field at Alhambra, in the southern part of the state, distinguished itself for strength of flour. In a few instances loaves of excellent size were produced. For the most part, however, they were medium to inferior in size. Mediterranean, Marvelous, and Illini Chief made the best records of those varieties tested for a period of two years or more. The two hard varieties, Ilred and Blackhull, scarcely equaled the better soft varieties in strength of flour.

Influence of Soil Type on Quality of Wheat.—A study was made of the relative response of varieties of wheat to soil type on thirteen fields located in a number of counties of the southern section of the state. The limited data present no conclusive evidence that any of the five varieties tested were consistently superior to the other varieties in protein content and baking strength when grown on any particular group of soils. In a study of wheat grown in Christian county, on two fields differing widely in soil type, all varieties grown on Black Clay Loam On Clay were much higher in protein content than those grown on Gray Silt Loam On Clay and nearly all were decidedly greater in strength of flour.

Quality of Wheat Produced by Farmers.—Sixty-two samples of wheat were obtained from individual growers in the southern section of the state. Twenty-seven percent of these made loaves of good size; the other 73 percent made loaves of medium or inferior size. Many of the latter had pale crusts which were lumpy or split.

Seventy-three samples of wheat representing carlots shipped from central Illinois to St. Louis and Indianapolis were tested. Four of the thirty-six samples of hard wheat produced loaves of good size; two

of the eighteen samples of soft wheat made loaves of good volume; while one of the nineteen samples of mixed wheat milled into flour of good strength.

Protein Content and Loaf Volume of Hard and Soft Wheats.—The protein content of all samples of hard red winter wheat grown on the various experimental plots and of samples representing carlots shipped from central Illinois to terminal markets averaged but slightly greater than that of the soft red winter wheat from the same sources. The average loaf volume of the hard wheat, however, materially exceeded that of the soft wheat.

Quality of Hard Spring Wheat.—In tests of the quality of varieties of hard spring wheat produced in Illinois, Kota at Urbana ranked first in baking strength, having a three-year average (1924-1926) of 14.45 percent protein and an average loaf volume of 2,035 cc. White Australian ranked second in baking strength, Marquis third, and Illinois No. 1 fourth. Illinois No. 1 made loaves of medium to small size and usually of inferior quality. At DeKalb, Marquis produced flour of excellent strength, ranking first in that respect during the same three-year period (1924-1926).

Comparison of Western and Northwestern Grown Seed Wheat With Illinois Grown Wheat.—Tests were made of the quality of hard red winter and hard spring wheat produced in Illinois from seed grown respectively in the hard red winter and hard spring wheat sections of the country. In this limited investigation it was found that successive crops of hard red winter wheat did not progressively deteriorate under Illinois conditions. The first crop was in some cases decidedly inferior in baking quality to the imported seed; in other instances the differences were not great. Subsequent crops in some cases showed considerable improvement over the first crop, depending on seasonal conditions. The data are too limited, however, to permit definite conclusions.

Hard spring wheat produced in Illinois from seed grown in North Dakota in some instances equaled or even exceeded in protein content and loaf volume the northern-grown wheat, the relative standing of the Illinois product depending on seasonal conditions and quality of original seed.

CONCLUSIONS

The data secured from this investigation appear to warrant the following conclusions.

1. Environmental conditions ordinarily existing in central and southern Illinois are not conducive to the production of winter wheat, either hard or soft, which mills into strong flour as measured by the standards used in this investigation. Seasonal and peculiar local conditions, however, cause numerous exceptions to the above statement.

2. If the winter wheat grown on the DeKalb field is representative of that generally grown in the northern section of Illinois, then it may be concluded that the baking quality of the flour milled from the winter wheat from this section can usually be counted on to be good to excellent.

3. A few varieties of winter wheat seem to maintain their ability to produce flour of good quality in spite of the unfavorable environmental conditions of central Illinois. This suggests an opportunity for the plant breeder to develop varieties of hard winter wheat which, when grown in this area, will consistently produce flour of good quality and at the same time possess other desirable characteristics.

4. Hard spring wheat of high protein content which will mill into flour of excellent strength may be grown in both central and northern Illinois.

While it is desirable that further investigations be made of the quality of Illinois grown hard red winter and hard spring wheat as compared with the quality of the same classes produced in the hard wheat sections of the West and Northwest, it seems scarcely probable that Illinois can consistently compete with the West and Northwest in the profitable production of high-grade bread wheats. Since, however, there is a large demand for soft-wheat flour for other purposes than yeast-lightened bread, future investigation may well give special attention to soft wheat. The characteristics of flour best suited for making each of the various classes of soft-wheat flour products, such as biscuits, cakes, crackers, etc., the relative adaptability of different varieties for milling purposes, and the effect of environmental conditions peculiar to the various parts of Illinois on the quality of the grain produced, present an excellent field for future investigations.

APPENDIX

TABLE 14.—ANNUAL ANALYTICAL DATA AND MILLING AND BAKING TESTS OF VARIETIES OF WINTER WHEAT GROWN ON THE EXPERIMENT FIELD AT URBANA, CHAMPAIGN COUNTY[1]

Sample No.	Year	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
		Uncleaned	Cleaned		Wheat	Flour							
Turkey Red (Station)		*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
1	1922	58.6	....	68.0	10.12	8.95	....	57.0	494	2 050	95	Normal	35.6
9	1923	59.1	....	75.3	14.20	11.69	....	53.5	460	1 800	93	96	35.7
32	1924	61.4	63.6	76.1	11.18	9.63	.401	53.5	490	1 645	97	98	40.3
285	1925	61.0	63.3	71.5	12.09	10.80	.421	54.4	472	1 745	96	97	44.5
443	1926	61.9	63.8	75.4	12.94	11.87	.468	51.2	472	1 965	98	101	43.1
	Average	60.4	....	73.3	12.10	10.59	....	53.9	478	1 840	95.8	...	39.8
Ilred													
2	1922	58.4	....	59.6	9.64	8.93	....	58.2	498	1 688	97	Normal	35.7
8	1923	....	....	76.7	13.01	11.42	....	53.2	463	1 735	94	95	40.6
40	1924	59.9	63.4	75.4	11.09	9.84	.420	54.1	485	1 575	97	97	43.8
286	1925	61.1	63.4	73.0	11.79	10.71	.483	56.5	484	1 750	96	95	44.6
432	1926	60.0	61.7	74.7	12.08	11.49	.485	52.9	486	1 890	97	100	47.2
	Average	....	....	71.9	11.52	10.48	....	55.0	483	1 730	96.2	...	42.4
Minnesota Reliable													
6	1922	59.9	....	74.7	9.75	8.31	....	58.7	484	1 688	97	Normal	43.9
14	1923	57.5	....	74.5	13.55	11.38	....	53.8	460	1 970	95	98	43.0
22	1924	60.3	62.3	76.9	11.80	10.09	.475	53.2	479	1 830	98	98	41.6
287	1925	61.1	63.2	73.9	12.78	11.80	.458	55.0	480	1 945	96	97	44.2
421	1926	60.8	62.4	73.6	11.75	10.86	.561	50.9	467	2 025	98	100	45.7
	Average	59.9	....	74.7	11.93	10.49	....	54.3	474	1 870	96.8	...	43.7
Kanred													
5	1922	56.7	....	67.7	10.77	9.59	....	54.9	487	1 835	94	Normal	35.6
3	1923	55.8	....	70.7	13.72	11.82	....	54.7	468	1 815	94	97	35.3
42	1924	58.9	63.0	77.6	11.07	9.79	.445	55.6	486	1 540	97	97	41.7
264	1925	60.6	62.7	74.8	12.17	11.58	.457	60.0	497	1 700	97	96	46.3
436	1926	61.0	62.9	77.2	12.08	11.25	.481	52.1	480	1 805	97	98	50.6
	Average	58.6	....	73.6	11.96	10.81	....	55.5	484	1 750	95.8	...	41.9
Blackhull													
20	1922	61.6	....	73.1	10.00	8.95	....	52.7	480	1 393	96	Normal	46.7
6	1923	60.2	....	75.5	13.18	11.43	....	49.4	442	1 695	94	97	45.9
20	1924	61.3	63.5	75.9	11.24	9.91	.423	50.9	471	1 820	98	96	38.6
262	1925	63.7	64.5	73.2	12.33	11.06	.431	59.1	497	1 700	97	95	48.9
440	1926	60.4	62.7	73.4	12.27	11.83	.492	52.6	475	2 070	97	98	39.1
	Average	61.4	....	74.2	11.80	10.64	....	52.9	473	1 735	96.4	...	43.8

[1]The samples tested in 1922 were milled and baking tests made by the Howard Wheat and Flour Testing Laboratory of Minneapolis, Minn. The low flour yields for that year are probably to be attributed to a difference in methods of milling. While the baking tests by the Howard Laboratory undoubtedly were made in a different manner from those made later in the Experiment Station laboratory, the data from the two sources seem to be in accord.

TABLE 14.—*Continued*

Sample No.	Year	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
		Uncleaned	Cleaned		Wheat	Flour							
Worlds Champion		*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
8	1922	58.6	....	70.0	9.55	8.27	....	56.5	493	1 671	97	Normal	40.4
4	1923	58.5	....	78.4	12.98	11.27	....	54.7	470	1 565	97	99	44.2
27	1924	61.3	63.4	73.0	11.04	9.66	.400	55.0	487	1 710	98	98	43.2
283	1925	60.9	63.3	71.5	12.42	11.30	.452	55.0	483	1 700	97	96	42.1
437	1926	60.4	62.2	73.7	12.07	11.63	.432	52.3	470	1 985	98	101	44.1
	Average	59.9	....	73.3	11.61	10.43	....	54.7	481	1 725	97.4	...	42.8
Michigan Amber													
21	1922	58.7	....	69.7	10.09	8.46	....	57.1	496	1 885	98	Normal	39.5
13	1923	57.5	....	71.4	13.30	10.98	....	54.7	473	1 715	96	95	45.4
37	1924	60.7	62.4	70.6	11.19	9.63	.470	55.0	493	1 545	97	97	38.3
265	1925	59.3	61.8	71.0	12.88	11.22	.448	57.6	493	1 630	97	97	42.8
434	1926	60.2	62.0	72.5	12.26	11.66	.447	50.6	476	1 770	98	98	37.7
	Average	59.3	....	71.0	11.94	10.39	....	55.0	486	1 710	97.2	..	40.7
Gladden													
17	1922	59.0	....	68.3	9.26	7.43	....	53.8	477	1 720	99	Normal	39.7
19	1923	59.0	....	74.0	12.43	10.65	....	51.5	464	1 470	95	95	46.0
29	1924	60.4	62.9	68.9	10.78	9.53	.390	50.9	480	1 545	98	94	37.4
271	1925	61.2	62.6	71.8	12.92	11.52	.439	55.6	495	1 665	96	94	43.6
423	1926	59.2	61.1	74.2	12.11	11.05	.535	50.3	472	1 720	96	90	43.3
	Average	59.8	....	71.4	11.50	10.44	....	52.4	478	1 625	96.8	..	42.0
Malakof 5-460													
4	1922	58.1	....	69.2	9.49	8.11	....	57.7	494	1 850	98	Normal	36.3
22	1923	58.6	....	75.1	13.10	11.38	....	50.3	456	1 545	95	97	43.3
39	1924	59.8	62.8	74.4	11.31	9.93	.419	55.6	490	1 650	97	97	43.3
274	1925	59.1	62.7	71.2	12.58	10.85	.487	57.6	476	1 745	96	98	38.9
	Average	58.9	....	72.5	11.62	10.07	....	55.3	479	1 700	96.5	..	40.4
Indiana Swamp													
13	1922	59.9	....	72.4	9.83	8.76	....	58.2	496	1 915	97	Normal	40.3
10	1923	59.8	....	76.1	12.81	11.35	....	51.8	457	2 105	96	99	44.3
33	1924	62.1	64.2	73.6	11.61	9.70	.424	55.3	492	1 620	98	98	45.5
289	1925	60.7	63.1	71.8	12.65	11.43	.581	56.2	489	1 750	96	97	43.5
	Average	60.6	....	73.5	11.73	10.31	....	55.4	484	1 850	96.8	..	43.4
Red Cross													
14	1922	58.4	....	70.5	9.87	8.39	....	55.5	489	1 720	98	Normal	35.5
5	1923	59.2	....	72.3	12.53	10.74	....	47.5	451	1 780	95	97	42.4
26	1924	61.4	63.1	69.7	11.59	9.84	.355	50.9	480	1 680	99	96	39.1
269	1925	60.2	63.1	61.3	12.75	.....	.445	57.6	493	1 765	98	93	42.8
	Average	59.8	....	68.5	11.68	.....	....	52.9	478	1 735	97.5	..	39.9

TABLE 14.—*Continued*

Sample No.	Year	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
		Uncleaned	Cleaned		Wheat	Flour							
Dawson Golden Chaff 9-225		*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
23	1922	57.0	....	71.1	9.05	7.48	....	53.8	479	1 325	98	Normal	37.2
11	1923	57.8	....	76.5	12.99	10.98	....	50.9	457	1 910	94	98	47.7
35	1924	60.7	62.6	73.5	10.77	9.11	.386	50.6	472	1 540	97	96	40.5
284	1925	60.4	62.8	72.9	11.38	10.20	.452	54.1	478	1 630	96	96	43.8
	Average	59.0	....	73.5	11.05	9.44	....	52.3	472	1 600	96.3	..	42.3
Red Russian													
7	1923	58.7	....	75.3	13.43	11.50	....	52.9	467	1 830	93	96	41.7
21	1924	60.8	62.9	76.9	11.89	10.18	.428	53.2	479	1 805	97	95	48.5
272	1925	61.0	62.9	71.0	12.55	10.74	.497	58.0	483	1 865	95	90	44.9
427	1926	59.8	62 0	80.1	12.15	11.32	.518	50.3	470	1 960	95	98	44.0
	Average	60.1	....	75.8	12.50	10.93	....	53.6	475	1 865	95	94.8	44.8
Malakof C. I. 4898													
24	1923	58.2	....	73.1	15.54	12.78	....	50.3	457	1 840	93	97	37.7
19	1924	61.4	63.5	76.9	11.93	10.03	.414	52.1	469	1 770	96	96	43.3
290	1925	61.5	63.4	75.9	12.40	11.10	.522	55.6	478	1 745	92	80	47.4
439	1926	58.2	60.8	74.6	13.14	12.33	.463	50.3	471	2 145	95	101	29.3
	Average	59.8	....	74.9	13.25	11.56	....	52.1	469	1 875	94	93.5	39.4
Michikof													
14	1923	62.3	63.5	67.5	12.42	10.35	.419	52.9	479	2 020	96	97	....
15	1924	61.5	63.0	70.0	13.34	11.10	.440	53.2	475	2 045	96	97	41.5
266	1925	60.1	63.2	73.2	13.97	12.68	.511	60.6	494	1 870	97	97	43.9
430	1926	60.5	62.5	73.6	13.57	.....	.513	52.3	471	2 100	97	100	38.1
	Average	61.1	63.0	71.1	13.23	.....	.471	54.8	480	2 010	96.5	97.8	41.2
Hardy Northern													
27	1923	....	....	68.6	12.62	10.78	...	51.8	473	1 985	97	95	34.8
28	1924	61.5	62.6	71.9	11.08	9.89	.417	54.1	485	1 690	97	98	42.3
270	1925	59.3	61.6	70.7	14.57	12.69	.496	56.7	483	1 840	97	96	36.0
400	1926	60.4	61.9	74.7	12.00	11.13	.484	49.1	459	2 100	97	98	40.6
	Average	....	....	71.5	12.56	11.12	....	52.9	475	1 905	97	96.8	38.4
Altara 2048													
41	1924	62.0	64.4	77.2	11.06	10.02	.417	55.0	485	1 530	97	96	40.0
275	1925	61.5	64.2	73.3	12.81	10.50	.451	60.0	500	1 750	96	97	44.4
424	1926	60.8	62.8	75.8	12.26	11.28	.528	52.9	479	1 870	96	97	43.2
	Average	61.4	63.8	75.4	12.04	10.57	.449	56.0	488	1 715	96.3	96.6	42.5
Minturki													
16 and 17	1924	61.3	63.0	74.6	11.79	10.29	.356	50.6	474	1 980	96	97	45.4
263	1925	60.6	62.3	73.8	12.37	11.31	.456	56.8	493	1 460	95	90	43.6
433	1926	60.0	62.0	77.4	12.16	11.19	.461	52.3	465	2 080	97	100	44.2
	Average	60.6	62.4	75.3	12.11	10.93	.424	53.2	477	1 840	96	95.7	44.4

TABLE 14.—*Concluded*

Sample No.	Year	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
		Uncleaned	Cleaned		Wheat	Flour							
		lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
Berkeley Rock													
38	1924	55.5	59.5	76.3	12.51	10.91	.547	55.0	489	1 570	98	98	20.9
282	1925	59.3	62.5	71.9	13.36	12.18	.546	57.9	487	1 780	96	97	39.3
442	1926	58.8	60.8	73.3	13.72	12.98	.543	52.1	477	1 955	97	99	30.1
	Average	57.9	60.9	73.8	13.20	12.02	.545	55.0	484	1 770	97	98	30.1
Fulhio													
23	1924	61.0	62.4	74.6	11.60	10.13	.414	51.8	475	1 660	96	94	36.4
280	1925	59.6	61.9	73.9	12.90	11.44	.462	52.6	481	1 630	96	96	41.5
429	1926	58.8	60.7	76.2	12.64	11.33	.454	51.8	477	1 730	95	95	32.0
	Average	59.8	61 7	74.9	12.38	10.97	.443	52.1	478	1 675	95.7	95	36.6
Trumbull													
30	1924	58.1	60.4	70.5	11.93	10.22	.428	50.9	476	1 535	97	95	37.4
288	1925	59.7	61.6	72.5	13.02	11.76	.527	53.8	470	1 805	96	90	38.9
419	1926	57.8	60.0	72.1	12.82	11.59	.331	51.8	483	1 940	97	97	31.9
	Average	58.5	60.7	71.7	12.59	11.19	.429	52.2	476	1 755	96.7	94	36.1
Mediterranean													
19	1922	59.6	....	69.5	10.08	8.62	....	52.2	479	1 425	97	Normal	39.7
16	1923	58.6	....	76.3	13.78	11.69	....	52.1	460	1 752	94	95	44.3
25	1924	61.6	63.4	74.7	10.47	9.84	.461	50.0	476	1 525	97	95	36.4
	Average	59.9	....	73.5	11.44	10.05	....	51.4	472	1 565	96	..	40.1
Purkof													
273	1925	59.8	61.5	67.2	12.40	11.45	.480	57.7	...	1 780	96	99	46.4
431	1926	59.2	60.5	74.9	13.22	11.37	.482	51.8	476	1 775	97	99	46.8
	Average	59.5	61.0	71.0	12.81	11.41	.481	54.7	...	1 775	96.5	99	46.6
Honor													
267	1925	58.2	60.8	75.0	12.07	10.74	.470	55.0	486	1 540	97	93	38.7
422	1926	56.0	58.6	72.8	11.51	9.96	.568	50.3	471	1 610	95	90	26.3
	Average	57.1	59.7	73.9	11.79	10.35	.519	52.6	478	1 575	96	91.5	32.5
Kanred 2401													
18	1924	59.3	62.1	74.7	10.75	9.36	.368	52.4	478	1 755	96	94	44.1
426	1926	60.7	62.5	75.7	11.89	11.24	.491	51.2	478	1 810	97	97	51.1
	Average	60.0	62.3	75.2	11.32	10.80	.429	51.8	478	1 780	96.5	95.5	47.6
Fulcaster (Mo.)													
34	1924	58.5	61.3	71.8	10.86	9.48	.436	52.9	481	1 590	97	96	21.1
278	1925	60.5	62.9	69.3	12.73	10.96	.503	57.0	490	1 710	96	97	41.8
	Average	59.5	62.1	70.5	11.79	10.22	.469	54.9	485	1 650	96.5	96.5	31.4
Poole													
36	1924	58.9	60.8	73.1	11.59	9.98	.484	52.1	477	1 550	97	96	25.7
Kanred (cert.)													
435	1926	60.3	62.5	76.9	13.20	11.11	.482	51.8	476	1 805	97	98	....
Turkey Red (cert.)													
438	1926	60.3	62.5	74.4	12.53	11.39	.428	52.7	475	1 920	97	101	....
Progeny No. 2													
428	1926	61.9	63.7	77.2	12.99	11.47	.477	51.7	467	1 985	95	98	....
Winter Fife													
425	1926	56.5	58.4	73.2	10.41	9.21	.472	48.5	470	1 760	97	97	....
T.R.P.B. Sel.													
441	1926	61.7	62.8	74.2	12.61	11.54	.484	51.5	468	2 020	98	101	....

TABLE 15.—ANNUAL ANALYTICAL DATA AND RESULTS OF MILLING AND BAKING TESTS OF VARIETIES OF WINTER WHEAT GROWN ON THE EXPERIMENT FIELD AT DEKALB, DEKALB COUNTY[1]

Sample No.	Year	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
		Uncleaned	Cleaned		Wheat	Flour							
Turkey Red (Station)		*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
25	1922	....	....	71.8	.....	9.45	....	58.2	496	1 803	97	Normal	46.9
1	1923	58.7	....	73.8	13.33	10.35	....	55.3	462	1 960	96	99	41.7
51	1924	58.2	60.7	71.4	9.69	8.58	.441	57.4	478	1 995	98	97	46.1
260	1925	61.0	63.1	72.3	11.03	9.80	.512	58.2	486	1 985	97	100	33.0
397	1926	58.4	61.1	71.6	11.26	9.96	.380	51.5	470	2 010	96	101	46.3
	Average	....	....	72.2	.....	9.63	....	56.1	478	1 950	97	...	42.8
Minnesota Reliable													
30	1922	....	....	71.8	.....	9.76	....	57.7	493	2 325	98	Normal	44.0
7	1923	57.7	....	63.6	12.98	10.91	....	53.8	467	2 180	96	99	37.8
60	1924	58.9	61.1	71.3	10.31	8.80	.425	53.2	469	2 090	98	101	45.9
254	1925	60.2	62.4	71.6	11.23	9.98	.489	57.4	488	1 990	98	98	44.2
401	1926	56.8	59.9	75.0	12.17	11.00	.370	51.2	467	2 225	97	102	44.2
	Average	....	....	70.7	.....	10.09	....	54.7	477	2 162	97.4	...	44.0
Ilred													
26	1922	....	....	71.2	.....	8.98	....	57.7	496	1 835	99	Normal	45.2
8	1923	58.9	....	63.0	12.49	10.34	....	53.2	467	2 110	96	99	42.2
59	1924	57.5	60.0	73.7	9.13	7.86	.405	54.1	465	1 970	97	92	44.1
246	1925	60.0	63.0	72.6	10.64	9.67	.500	57.1	491	2 090	98	102	42.2
396	1926	58.9	61.4	71.8	11.15	10.34	.380	53.2	480	1 730	94	95	51.4
	Average	....	....	56.5	.....	9.44	....	55.1	480	1 947	96.8	..	45.0
Kanred													
27	1922	....	....	74.4	.....	9.90	....	59.2	502	2 032	97	Normal	44.4
11	1923	56.8	....	74.5	.....	9.74	....	50.9	463	1 875	97	96	42.5
58	1924	57.9	60.5	76.0	9.76	8.57	.420	54.1	478	1 790	98	96	45.5
253	1925	60.0	62.0	73.7	11.01	8.58	.528	57.9	489	1 880	97	98	46.1
400	1926	57.9	60.4	74.8	11.60	10.49	.350	52.1	474	2 095	95	100	44.9
	Average	....	....	74.7	.....	9.46	....	54.8	481	1 934	96.8	...	44.7
Hardy Northern													
28	1922	....	....	68.7	.....	8.75	....	57.7	496	1 885	97	Normal	45.5
10	1923	58.7	....	67.9	12.36	10.75	....	52.1	457	2 150	95	98	38.5
54	1924	58.9	61.2	74.9	9.73	8.66	.420	53.5	480	2 005	97	99	44.0
255	1925	60.7	63.2	73.6	10.51	9.48	.507	54.7	484	1 905	97	97	37.8
398	1926	58.4	61.1	72.6	10.52	9.45	.420	51.5	478	2 060	96	102	44.2
	Average	....	....	71.5	.....	9.42	....	53.9	479	2 000	96.4	...	42.0
Red Russian													
29	1922	....	....	72.9	.....	9.57	....	54.9	489	1 688	98	Normal	49.3
2	1923	58.2	....	75.1	12.57	10.77	....	52.9	469	1 930	96	99	42.2
61	1924	58.8	61.4	73.2	9.67	8.53	.470	54.1	481	1 895	98	100	46.5
259	1925	61.2	62.6	74.1	11.00	9.80	.511	56.5	485	2 000	97	101	44.7
402	1926	58.2	61.0	75.0	12.18	10.99	.430	51.5	474	2 125	96	99	46.1
	Average	....	....	74.1	.....	9.93	....	54.0	480	1 930	97	..	45.8

[1]The samples tested in 1922 were milled and a baking test made by the Howard Wheat and Flour Testing Laboratory of Minneapolis, Minn. The low flour yields for that year probably are to be attributed to a difference in methods of milling. While the baking tests by the Howard Laboratory undoubtedly were made in a different manner from those made later in the Experiment Station laboratory, the data from the two sources seem to be in accord.

TABLE 15.—*Concluded*

Sample No.	Year	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
		Uncleaned	Cleaned		Wheat	Flour							
		lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
Red Cross													
33	1922	....	....	68.8	.....	8.75	....	57.0	489	1 966	96	Normal	40.5
5	1923	57.9	....	72.9	12.41	10.68	....	52.9	463	1 800	96	98	38.3
52	1924	57.9	60.5	70.0	8.93	8.42	.420	58.2	481	2 170	99	98	45.3
245	1925	60.1	62.4	71.3	10.97	9.80	.529	57.4	489	2 060	98	101	36.8
	Average	....	....	70.7	.....	9.41	....	56.4	480	2 000	97.3	...	40.2
Blackhull													
4	1923	58.8	....	76.1	13.17	10.91	....	52.9	458	1 940	97	98	35.6
56	1924	59.2	62.1	77.0	9.99	8.36	.397	51.8	469	2 045	97	94	40.3
244	1925	61.6	63.8	72.1	10.92	10.04	.500	57.9	493	2 080	98	101	35.4
395	1926	60.6	62.5	74.3	11.69	10.66	.360	52.3	481	2 070	97	101	46.3
	Average	60.0	....	74.9	11.44	9.99	....	53.7	475	2 034	97.3	96	39.4
Michikof													
57	1924	60.3	62.7	77.0	11.42	10.18	.410	53.8	471	2 160	98	100	38.7
252	1925	62.0	64.3	71.1	11.11	10.39	.538	60.6	505	1 790	97	97	42.6
403	1926	60.1	63.1	72.9	11.03	10.37	.460	52.9	478	2 025	97	100	42.0
	Average	60.8	63.4	73.7	11.19	10.31	.469	55.8	485	1 992	97.3	99	41.1
Wisconsin No. 18													
31	1922	....	....	72.9	.....	9.23	....	56.0	493	1 966	98	Normal	44.6
3	1923	57.9	....	71.8	12.04	10.27	....	54.1	460	2 030	97	100	39.9
53	1924	57.9	60.4	72.0	9.68	8.35	.385	54.4	487	1 920	98	97	45.3
	Average	....	....	72.2	.....	9.28	....	54.8	480	1 970	97.7	..	43.3
Fulhio													
50	1924	58.1	60.6	71.0	10.60	9.82	.427	56.2	486	1 955	99	100	40.5
247	1925	60.4	61.7	70.7	10.40	9.46	.473	56.5	487	1 860	98	98	42.1
405	1926	57.5	60.1	74.5	10.61	9.55	.370	59.1	470	1 845	97	98	29.1
	Average	58.7	60.8	72.1	10.54	9.61	.423	57.3	481	1 885	98	98.7	37.2
Trumbull													
62	1924	59.6	61.4	71.8	10.71	9.68	.480	51.8	471	1 510	95	97	37.5
250	1925	60.0	61.8	70.6	11.60	9.46	.393	56.5	487	1 970	98	102	38.2
404	1926	57.1	59.9	73.1	11.12	10.08	.370	49.4	465	2 050	98	102	30.0
	Average	58.9	61.0	71.8	11.14	9.74	.414	52.6	474	1 845	97	100	35.2
Minturki													
256	1925	60.6	62.8	73.0	10.54	9.02	.456	54.4	479	1 820	96	96	43.7
406	1926	58.9	61.6	73.4	10.90	9.53	.390	50.6	467	1 830	95	97	43.7
	Average	59.8	62.2	73.2	10.72	9.27	.423	52.5	473	1 825	95.5	96.5	43.7
Purkof													
399	1926	56.7	59.3	70.5	11.05	9.87	.310	51.4	478	1 920	99	101	46.8
Winter Fife													
407	1926	55.3	58.4	74.5	10.84	9.66	.380	49.1	468	1 910	97	101	44.0

TABLE 16.—ANNUAL ANALYTICAL DATA AND RESULTS OF MILLING AND BAKING TEST OF VARIETIES OF WINTER WHEAT GROWN ON THE EXPERIMENT FIELD AT ALHAMBRA, MADISON COUNTY

Sample No.	Year	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
		Uncleaned	Cleaned		Wheat	Flour							
Fulcaster		*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
47	1922	57.9	....	70.7	9.74	7.86	....	52.2	469	1 885	98	Normal	31.8
10	1923	59.3	....	66.3	12.96	10.86	....	49.1	464	1 800	97	97	34.6
292	1925	57.3	59.4	71.9	9.67	8.28	.445	54.4	486	1 730	98	98	22.2
461	1926	59.6	61.6	74.3	11.70	10.28	.495	52.9	478	1 845	96	98	20.6
	Average	58.5	....	70.8	11.02	9.32	....	52.1	474	1 815	97.5	97.7	27.3
Illini Chief													
54	1922	55.4	....	69.1	12.35	10.32	....	52.7	479	1 965	99	Normal	29.1
7	1923	58.2	....	68.3	12.64	10.69	....	47.3	464	1 700	97	95	31.9
291	1925	55.8	58.3	71.4	9.26	8.12	.454	52.4	469	1 790	98	98	22.5
451	1926	57.2	59.7	74.1	10.61	9.38	.471	51.5	468	1 810	97	98	22.1
	Average	56.7	....	71.0	11.07	9.63	....	51.0	470	1 816	97.8	97	26.4
Mediterranean													
52	1922	56.0	....	71.5	9.39	7.53	....	52.2	473	1 360	99	Normal	28.9
14	1923	60.5	....	68.0	13.17	10.44	....	50.0	469	2 035	96	99	39.6
303	1925	57.8	59.5	72.6	10.59	8.90	.532	52.4	470	2 050	98	101	23.9
449	1926	57.7	60.3	73.2	11.00	9.20	.461	51.2	478	1 800	96	96	17.1
	Average	58.0	....	71.3	11.04	9.02	....	51.4	472	1 811	97.2	98.7	27.4
Ilred													
46	1922	55.8	....	70.0	9.71	8.04	....	53.8	480	1 690	97	Normal	21.3
11	1923	59.2	....	65.6	13.55	11.31	....	58.2	475	1 990	94	95	31.9
300	1925	57.0	59.1	70.4	9.02	8.18	.465	56.5	496	1 755	96	99	22.6
455	1926	59.5	61.2	75.9	9.82	8.69	.490	53.5	483	1 700	96	97	23.1
	Average	57.9	....	70.5	10.53	9.06	....	55.5	483	1 784	95.8	97	24.7
Blackhull													
53	1922	58.3	....	67.7	10.06	8.69	....	55.5	491	1 395	98	Normal	33.7
13	1923	59.7	....	74.0	14.03	11.84	....	53.8	455	1 900	94	98	27.8
293	1925	57.9	61.4	71.2	9.33	8.15	.492	56.2	488	1 685	97	90	24.3
450	1926	61.1	63.3	73.8	10.16	9.06	.475	52.1	477	1 810	96	97	20.3
	Average	59.3	....	71.7	10.90	9.44	....	54.4	478	1 698	96.3	95	26.5
Marvelous													
48	1922	54.0	....	69.4	9.94	7.79	....	52.2	471	1 885	99	Normal	23.3
12	1923	59.3	....	66.1	11.59	9.49	....	56.5	471	1 960	96	99	37.7
	Average	56.7	....	67.8	10.74	8.64	....	54.3	471	1 922	97.5	..	30.5
Gipsy													
49	1922	55.2	....	70.1	9.70	7.66	....	52.2	475	1 935	98	Normal	23.4
9	1923	57.5	....	73.0	11.30	9.96	....	50.0	463	1 815	97	97	38.5
	Average	56.4	....	71.6	10.50	8.81	....	51.1	469	1 875	97.5	..	31.0

TABLE 16.—*Concluded*

Sample No.	Year	Weight per bushel		Flour yield	Crude protein (N×5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
		Uncleaned	Cleaned		Wheat	Flour							
		lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
Jersey Fultz													
50	1922	54.7	....	70.5	9.14	7.33	....	53.2	482	1 935	99	Normal	25.2
6	1923	59.0	....	66.8	12.43	10.88	....	50.6	475	1 745	96	98	36.1
	Average	56.9	....	68.7	10.79	9.10	....	51.9	478	1 840	97.5	..	30.7
Rudy													
51	1922	55.2	....	68.9	9.24	7.27	....	53.2	480	1 690	98	Normal	31.4
15	1923	60.4	....	65.0	13.23	10.29	....	51.8	475	1 820	97	97	38.6
	Average	57.8	....	67.0	11.24	8.78	....	52.5	477	1 755	97.5	..	35.0
Harvest Queen													
55	1922	54.8	....	67.2	10.33	8.42	....	56.4	494	1 690	98	Normal	17.1
5	1923	59.9	....	64.2	13.30	11.48	....	58.8	474	1 575	96	94	32.9
	Average	57.4	....	65.7	11.82	9.95	....	57.6	484	1 632	97	..	25.0
Red Wave													
56	1922	53.9	....	67.6	9.08	7.02	....	52.2	469	1 375	98	Normal	26.0
8	1923	55.9	....	71.2	10.56	8.98	....	47.9	465	1 540	97	95	38.4
	Average	54.9	....	69.4	9.82	8.00	....	50.0	467	1 457	97.5	..	32.2
Gladden													
294	1925	57.3	59.5	72.6	9.53	8.16	.442	52.3	472	1 725	98	100	25.1
452	1926	57.7	60.3	74.6	10.25	8.92	.436	52.4	481	1 765	97	97	25.0
	Average	57.5	....	73.6	9.89	8.54	.439	52.3	476	1 745	97.5	..	25.0
Shepherd													
295	1925	53.8	57.9	70.1	9.52	8.33	.508	55.9	487	1 655	98	97	24.9
457	1926	56.4	59.7	74.7	11.08	9.52	.430	52.9	486	1 710	96	96	14.4
	Average	55.1	....	73.9	10.30	8.92	.469	54.4	486	1 682	97	..	19.7
Poole													
296	1925	55.7	58.2	72.4	.....	8.55	.470	53.2	485	1 775	97	98	23.6
454	1926	56.9	59.7	73.4	11.41	10.03	.474	51.2	472	1 760	96	97	17.6
	Average	56.3	....	72.9	.....	9.29	.472	52.2	478	1 668	96.5	..	20.6
Fulhio													
297	1925	56.6	59.0	73.3	9.83	8.56	.460	53.2	480	1 740	96	97	26.4
460	1926	57.2	59.7	76.3	10.94	9.45	.439	52.6	486	1 710	96	95	17.2
	Average	56.9	....	74.8	10.39	9.00	.449	52.9	483	1 725	96	..	21.8
Trumbull													
302	1925	55.8	58.1	69.9	9.53	8.24	.455	51.2	473	1 765	98	100	23.9
458	1926	55.6	58.0	74.2	10.64	9.59	.439	50.9	468	1 755	96	97	16.6
	Average	55.7	....	72.0	10.09	8.91	.447	51.0	470	1 760	97	..	20.3
Michigan Amber													
304	1925	56.0	59.3	68.9	9.45	8.10	.471	52.6	464	1 745	97	98	25.7
453	1926	58.7	61.1	73.6	11.19	9.77	.458	52.6	483	1 790	97	97	24.9
	Average	57.4	....	71.3	10.32	8.93	.464	52.6	473	1 768	97	..	25.3

TABLE 17.—ANALYTICAL DATA AND RESULTS OF MILLING AND BAKING TESTS OF VARIETIES OF WHEAT GROWN IN 1926 ON THIRTEEN SERIES OF HAND-SOWN PLOTS LOCATED ON DIFFERENT TYPES OF SOIL IN SOUTHERN ILLINOIS

Sample No.	Where grown	Character of subsoil[1]	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
			Uncleaned	Cleaned		Wheat	Flour							
Shepherd			*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
471	Effingham	1	54.8	58.1	73.6	10.07	8.85	.433	54.1	489	1 555	97	96	12.3
486	Mt. Vernon	1	60.6	62.7	73.8	10.88	9.35	.451	52.4	489	1 465	97	96	33.9
501	Patoka	1	61.0	62.9	73.1	12.51	11.02	.421	54.1	475	1 610	97	97	40.9
531	Ashley	1	55.9	58.2	71.4	11.17	10.26	.446	55.9	488	1 570	95	95	16.4
476	Ernst	2	58.4	60.9	73.1	9.98	8.60	.444	52.9	478	1 560	97	97	41.2
481	Summerfield	2	58.2	60.2	72.9	9.98	8.45	.426	52.9	475	1 480	97	80	35.2
496	Albers	2	59.9	62.0	72.0	11.69	10.13	.401	55.0	492	1 460	97	94	38.8
526	Benton	2	54.3	56.3	67.3	16.36	15.22	.539	55.9	496	1 750	94	97	20.3
491	Centerville	3	57.0	58.7	72.2	13.06	11.29	.366	55.6	499	1 430	96	90	28.1
506	East Alton	3	55.0	57.6	72.8	12.09	10.50	.441	53.8	486	1 540	96	85	23.6
511	Pana	3	57.1	59.4	73.9	11.06	8.94	.438	52.4	483	1 450	97	96	10.1
516	Lawrenceville	3	61.0	63.1	75.7	10.66	9.11	.393	54.1	498	1 245	95	80	13.8
521	Albion	3	58.6	60.4	73.0	13.84	12.05	.362	55.9	488	1 640	96	95	22.0
	Average	..	57.8	60.0	72.7	11.80	10.29	.428	54.2	487	1 520	96.2	92.2	25.9
Michigan Amber														
472	Effingham	1	57.4	60.0	74.0	9.81	8.73	.435	54.4	491	1 520	97	97	21.0
487	Mt. Vernon	1	60.0	61.9	72.4	11.30	9.76	.494	52.9	491	1 550	97	96	25.9
502	Patoka	1	61.4	62.9	74.1	12.40	10.77	.427	53.8	486	1 570	97	97	45.4
532	Ashley	1	55.4	57.8	72.0	11.44	10.59	.485	55.9	486	1 625	95	96	13.3
477	Ernst	2	59.7	62.1	71.9	9.77	8.19	.429	52.6	485	1 570	97	97	46.8
482	Summerfield	2	59.4	61.2	73.8	9.94	8.30	.428	53.2	489	1 510	97	95	42.9
497	Albers	2	61.2	62.3	71.6	11.52	10.06	.429	55.0	491	1 535	97	96	37.3
527	Benton	2	52.0	54.0	66.2	18.01	16.49	.554	55.9	494	1 830	94	98	17.3
492	Centerville	3	57.9	59.8	73.6	13.52	11.57	.490	56.8	503	1 530	97	92	31.9
507	East Alton	3	57.9	60.1	73.4	11.72	10.34	.450	54.4	487	1 635	97	95	39.5
512	Pana	3	58.8	61.2	74.0	10.70	8.46	.445	52.1	485	1 725	97	98	22.2
517	Lawrenceville	3	61.4	63.4	75.1	10.16	8.60	.400	54.4	488	1 500	95	80	16.3
522	Albion	3	58.8	60.9	73.6	14.00	12.59	.382	55.9	495	1 755	96	97	17.3
	Average	..	58.6	60.6	72.7	11.87	10.34	.450	54.4	490	1 605	96.4	94.9	29.6

[1] 1 = subsoil very compact, plastic, and slowly pervious. 2 = subsoil compact and medium plastic. 3 = subsoil open and friable.

TABLE 17.—*Concluded*

Sample No.	Where grown	Character of subsoil[1]	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
			Uncleaned	Cleaned		Wheat	Flour							
Ilred			*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
473	Effingham	1	55.7	58.8	73.6	9.31	8.24	.522	57.4	493	1 550	96	96	16.9
488	Mt. Vernon	1	60.1	62.2	73.2	11.50	10.51	.558	55.0	477	1 645	96	97	20.9
503	Patoka	1	61.5	63.3	74.9	11.71	10.66	.492	54.4	487	1 750	97	97	40.3
478	Ernst	2	59.2	61.5	74.7	9.45	8.31	.492	54.7	487	1 670	96	97	43.7
483	Summerfield	2	58.6	60.4	74.2	9.10	7.67	.438	53.2	488	1 465	97	96	42.6
498	Albers	2	60.9	62.6	75.3	10.90	9.69	.467	55.0	490	1 455	97	97	39.9
528	Benton	2	52.1	54.1	67.6	19.34	18.61	.662	57.6	492	1 840	94	98	13.6
493	Centerville	3	57.1	59.1	72.3	12.40	10.72	.541	58.5	485	1 535	96	95	32.0
508	East Alton	3	56.9	59.2	74.4	11.87	10.35	.515	55.0	487	1 585	96	95	40.4
513	Pana	3	59.8	61.5	74.6	10.21	8.55	.512	54.4	482	1 600	97	96	28.4
518	Lawrenceville	3	61.0	62.9	74.8	9.72	8.52	.427	55.9	492	1 570	96	97	16.4
523	Albion	3	58.7	60.4	74.3	13.60	12.76	.414	57.4	487	1 645	96	97	20.3
	Average	..	58.5	60.5	73.7	11.59	10.38	.503	55.7	487	1 610	96.2	96.5	29.6
Fulcaster														
474	Effingham	1	55.7	59.0	75.0	10.12	8.71	.528	53.2	...	1 580	96	95	13.9
489	Mt. Vernon	1	61.1	63.2	72.1	10.73	9.13	.532	52.6	486	1 565	98	99	24.8
504	Patoka	1	61.3	63.0	71.8	12.70	10.81	.531	53.5	482	1 765	97	96	37.0
534	Ashley	1	56.2	58.5	73.5	10.67	9.46	.512	55.9	479	1 640	95	95	7.8
479	Ernst	2	60.7	62.8	75.8	9.44	8.10	.509	52.6	486	1 535	98	99	41.5
484	Summerfield	2	59.9	61.7	74.6	9.60	8.25	.487	53.5	485	1 535	98	96	38.1
499	Albers	2	61.1	63.1	73.7	11.43	9.91	.480	54.4	489	1 570	97	96	36.4
529	Benton	2	52.5	54.3	67.6	18.37	16.70	.580	57.4	490	1 840	94	98	14.6
494	Centerville	3	58.9	60.8	72.5	12.81	10.89	.527	56.8	498	1 585	97	96	31.1
509	East Alton	3	57.6	59.8	75.6	11.96	10.42	.539	54.4	483	1 615	96	95	31.7
514	Pana	3	58.6	60.4	74.3	10.34	8.49	.503	52.4	481	1 675	97	97	15.9
519	Lawrenceville	3	62.3	64.3	74.0	11.16	8.50	.441	54.4	491	1 615	97	98	14.5
524	Albion	3	58.5	60.6	74.8	13.91	12.45	.420	55.9	488	1 810	96	96	17.7
	Average	..	58.8	60.1	73.5	11.79	10.14	.506	54.4	487	1 640	96.6	96.6	25.0
Fulhio														
475	Effingham	1	56.3	59.4	74.4	10.40	9.06	.392	53.5	479	1 525	96	95	15.3
490	Mt. Vernon	1	61.4	63.1	74.8	10.85	9.40	.425	52.4	490	1 440	97	99	31.0
505	Patoka	1	60.2	62.1	75.1	12.52	10.92	.438	52.9	482	1 825	97	98	39.7
535	Ashley	1	55.4	57.7	72.7	11.30	10.45	.499	56.4	488	1 570	94	95	14.7
480	Ernst	2	59.1	61.5	75.9	9.49	8.19	.439	50.6	483	1 515	98	99	42.0
485	Summerfield	2	58.4	60.3	75.5	9.88	8.38	.423	53.5	488	1 510	97	95	39.9
500	Albers	2	59.8	61.9	75.8	11.24	10.04	.422	54.7	488	1 505	97	96	35.7
530	Benton	2	54.2	56.4	70.9	16.37	15.19	.495	55.9	486	1 850	95	98	21.8
495	Centerville	3	58.0	60.0	74.9	13.16	11.27	.451	56.5	493	1 565	97	96	30.2
510	East Alton	3	56.5	59.0	75.9	12.49	10.80	.478	53.8	487	1 495	96	96	34.4
515	Pana	3	58.6	60.4	75.9	10.63	8.93	.437	52.9	480	1 670	97	97	17.2
520	Lawrenceville	3	61.6	63.5	76.0	10.40	9.05	.378	54.1	490	1 670	97	98	15.1
525	Albion	3	59.3	61.4	74.8	13.61	12.41	.394	58.8	491	1 790	95	94	26.5
	Average	..	58.4	60.5	74.8	11.72	10.31	.436	54.3	487	1 610	96.4	96.6	28.0

TABLE 18.—ANALYTICAL DATA AND RESULTS OF MILLING AND BAKING TESTS OF SAMPLES OF WINTER WHEAT OBTAINED FROM FARMERS IN SOUTHERN ILLINOIS, CROP OF 1925

Sample No.	Post-office address	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb
		Uncleaned	Cleaned		Wheat	Flour						
	Lawrence county											
		lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*
165	Sumner	61.0	62.7	70.8	11.91	9.98	.461	52.6	481	1 935	97	98
179	Vincennes, Ind	58.2	59.4	71.1	11.01	9.60	.506	53.8	482	1 790	97	97
188	Lawrenceville	56.7	58.7	69.7	11.90	10.08	.482	53.8	479	1 720	96	96
212	Vincennes, Ind	56.4	58.7	69.4	11.51	9.98	.549	55.6	493	1 945	98	80
215	Sumner	55.9	58.4	67.5	11.81	10.00	.486	57.9	491	1 905	97	90
147	Lawrenceville	60.6	61.9	72.1	12.54	10.44	.322	48.8	462	2 075	97	100
213	Lawrenceville	59.3	60.9	66.2	11.28	9.02	.375	56.8	493	1 840	97	94
177	Lawrenceville	60.1	61.9	73.9	10.83	9.29	.394	50.3	474	1 935	98	101
208	Sumner	57.9	60.5	69.0	11.03	9.74	.435	54.1	484	1 860	97	97
	Average	58.5	60.3	70.0	11.54	9.79	.447	53.7	482	1 890	97.1	94.8
	Madison county											
154	Edwardsville	60.3	61.9	71.1	11.17	9.34	.378	49.1	463	1 940	98	102
156	Moro	58.1	59.7	70.0	10.94	9.48	.390	50.9	469	1 795	97	100
143	Godfrey	58.9	60.9	72.3	10.94	9.18	.373	46.8	453	1 885	98	100
144	Highland	54.1	57.9	70.7	10.92	9.34	.460	50.3	471	1 765	98	100
182	New Douglas	58.9	61.1	71.4	10.06	8.70	.465	52.3	477	1 870	98	100
194	St. Jacob	56.5	59.4	70.7	10.05	9.21	.424	53.2	474	1 945	98	99
211	Collinsville	56.8	59.6	69.7	9.46	8.33	.442	54.7	486	1 805	98	100
180	Moro	56.4	58.5	71.3	9.06	7.80	.458	52.1	477	1 605	98	96
198	Edwardsville	57.7	59.4	71.5	9.50	7.96	.425	52.1	473	1 565	98	96
206	East Alton	59.0	61.4	75.4	10.00	8.85	.462	53.5	465	1 770	98	96
163	Edwardsville	57.6	59.1	69.8	9.32	7.58	.390	52.1	473	1 635	98	98
186	Granite City	58.0	59.9	69.5	9.90	8.17	.451	51.5	477	1 580	97	95
157	St. Jacob	57.7	60.4	70.7	9.82	8.01	.405	51.8	472	1 825	98	99
207	Highland	56.0	57.7	70.2	10.96	9.52	.378	52.1	473	1 860	98	99
	Average	57.6	59.8	71.0	10.15	8.68	.421	51.6	472	1 775	97.8	98.5
	St. Clair county											
181	Mascoutah	59.7	60.9	73.8	10.21	9.05	.477	51.2	472	1 740	97	98
183	O'Fallon	59.9	61.5	70.8	12.06	10.31	.456	53.8	476	1 950	97	97
191	Belleville	59.6	60.6	70.8	10.44	9.09	.452	53.2	483	1 720	98	98
192	Belleville	58.6	60.9	73.0	10.90	9.53	.390	53.2	473	1 880	97	98
214	Belleville	59.7	61.3	70.0	10.23	9.03	.464	57.1	488	1 915	98	98
148	Millstadt	60.2	61.2	68.7	11.14	9.11	.394	51.5	470	1 875	97	98
216	Freeburg	58.3	60.6	72.8	10.67	9.35	.439	55.0	485	1 830	97	99
185	O'Fallon	59.5	61.4	70.0	9.38	....	....	52.1	473	1 895	97	100
149	Belleville	58.1	59.8	70.3	9.94	8.08	.400	50.0	461	1 700	98	97
168	Belleville	59.5	61.7	69.4	10.46	8.69	.376	51.8	479	1 785	98	99
204	Millstadt	59.3	61.4	71.0	10.77	9.57	.395	51.5	479	1 765	97	98
197	Summerfield	58.8	60.8	69.6	9.56	8.21	.465	54.4	482	1 740	98	97
199	Summerfield	58.6	60.2	70.9	10.15	9.03	.387	54.4	479	1 700	97	97
	Average	59.2	60.9	70.9	10.45	9.09	.425	53.0	477	1 807	97.4	98

TABLE 18.—*Concluded*

Sample No.	Post-office address	Weight per bushel		Flour yield	Crude protein (N×5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb
		Uncleaned	Cleaned		Wheat	Flour						
	Macoupin county											
		lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*
178	Carlinville	59.1	60.8	70.6	11.45	9.85	.477	50.9	476	1 830	98	99
205	Atwater	59.0	60.1	70.0	11.21	9.78	.451	53.8	483	1 745	97	97
174	Carlinville	59.7	62.3	70.3	10.38	9.58	.550	55.3	489	1 935	96	99
195	Shipman	57.9	60.1	72.8	11.19	9.87	.456	53.2	475	1 840	97	90
150	Chesterfield	58.1	61.0	72.0	11.53	9.96	.508	53.8	477	2 060	96	98
152	Atwater	57.7	60.1	69.7	11.86	10.60	.519	52.1	475	1 900	96	99
176	Carlinville	59.8	61.6	71.9	9.47	8.45	.542	52.1	477	1 870	96	95
	Average	58.8	60.9	71.0	11.01	9.73	.500	53.0	479	1 883	96.6	96.7
	Clay county											
190	Flora	57.8	59.1	69.8	12.35	11.12	.380	55.0	481	1 885	96	96
200	Clay City	58.2	59.7	69.4	13.53	11.87	.429	54.1	483	1 880	98	98
210	Clay City	59.4	60.9	70.8	16.47	13.77	.358	55.3	482	2 075	97	94
167	Iola	59.0	61.0	71.4	10.80	9.51	.388	52.1	490	1 835	98	100
173	Louisville	56.8	59.1	73.3	11.50	10.12	.420	54.1	479	2 210	99	100
175	Xenia	56.9	58.6	67.7	10.35	8.87	.402	53.5	484	1 780	98	99
189	Xenia	59.7	61.6	71.7	12.43	11.39	.418	53.8	476	1 805	96	80
	Average	58.3	60.0	70.6	12.49	10.95	.399	54.0	482	1 924	97.4	95.3
	Randolph county											
153	Red Bud	57.6	59.6	71.0	9.62	8.20	.368	50.3	466	1 815	97	99
184	Chester	58.9	60.1	66.0	11.50	7.92	.439	55.6	485	1 845	97	100
187	Red Bud	58.3	60.1	73.3	9.71	8.47	.446	52.9	474	1 765	96	97
209	Sparta	59.3	61.5	70.3	11.39	9.92	.452	57.1	489	1 990	97	96
202	Steeleville	59.8	60.9	71.5	9.67	8.32	.388	55.3	479	1 935	97	96
203	Sparta	59.4	61.3	71.4	10.37	8.98	.373	54.4	486	1 835	97	100
193	Red Bud	59.6	61.0	71.3	9.91	8.49	.416	53.2	478	1 775	97	97
196	Rockwood	59.5	60.9	69.4	10.46	9.20	.443	53.2	478	1 840	98	97
	Average	59.1	60.7	70.6	10.33	8.69	.416	54.0	479	1 850	97	97.7
	Miscellaneous											
146	New Burnside[1]	59.1	60.8	71.2	9.44	7.93	.414	51.8	469	1 735	97	98
151	Trenton[2]	58.5	60.1	69.3	10.25	8.33	.425	52.6	466	1 770	98	96
171	Dundas[3]	59.9	61.8	72.0	13.29	11.71	.390	53.5	479	2 155	97	102
179	Newton[4]	57.8	59.3	69.7	10.86	9.34	.484	51.8	473	1 805	98	97
	Average of all samples	58.5	60.4	70.7	10.85	9.35	.432	53.0	477	1 841	97.3	97.2

[1]Johnson county. [2]Clinton county. [3]Richland county. [4]Jasper county.

TABLE 19.—ANALYTICAL DATA AND RESULTS OF MILLING AND BAKING TESTS OF SAMPLES REPRESENTING CARLOTS OF WHEAT RECEIVED AT ST. LOUIS AND INDIANAPOLIS FROM SHIPPING POINTS IN CENTRAL ILLINOIS, CROP OF 1925

Sample No.	Source		Inspector's notes	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb
	Town	County		Uncleaned	Cleaned		Wheat	Flour						
						No. 1 hard red winter								
				lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*
325	Murdock	Douglas	.....	60.7	61.5	68.8	11.77	10.06	.380	55.9	490	1 860	96	97
330	Mahomet	Champaign	.....	61.1	62.6	73.0	11.37	10.21	.540	57.6	490	1 845	96	97
334	Booth	Grundy	DHW	61.9	63.1	71.9	12.81	11.49	.480	57.6	494	1 850	96	98
338	Gillum	McLean	.....	58.1	60.1	72.0	11.54	9.80	.480	56.5	485	1 950	97	97
343	Gillum	McLean	.....	60.9	62.7	73.4	12.11	10.99	.480	55.3	482	1 820	97	96
347	Meeks	Vermilion	.....	59.2	60.5	67.9	11.10	9.35	.510	57.9	495	1 865	95	96
349	Saybrook	McLean	.....	59.9	61.4	74.7	11.21	9.92	.440	56.2	483	1 865	96	97
350	Atwood	Piatt	.....	58.6	59.8	71.7	10.99	9.90	.450	56.2	487	1 840	96	96
353	Downs	McLean	.....	61.0	61.7	74.8	11.89	10.10	.500	52.4	478	1 690	96	96
357	Mahomet	Champaign	.....	59.0	60.3	70.6	11.95	10.19	.440	53.2	468	1 765	96	97
360	Rising	Champaign	.....	60.3	61.2	71.8	10.96	9.99	.370	51.8	475	1 745	95	97
361	Tremont	Tazewell	.....	59.2	60.7	74.0	12.28	10.51	.425	53.5	475	1 770	96	98
364	Saybrook	McLean	.....	60.7	62.0	72.8	10.56	9.13	.450	53.8	488	1 700	96	97
391	Mindale	Tazewell	.....	60.3	62.0	73.7	11.47	9.99	.340	54.1	474	2 010	95	94
	Average		.....	60.1	61.4	72.2	11.57	10.11	.449	55.1	483	1 827	95.9	96.6
						No. 2 hard red winter								
323	Newman	Douglas	10% RW	59.4	61.4	68.3	10.28	8.82	....	56.2	489	1 690	96	97
324	Murdock	Douglas	.....	58.9	60.7	68.3	11.14	9.04	.330	55.6	489	1 680	94	97
328	Redman	Edgar	.....	59.8	61.3	73.5	11.18	10.14	.350	55.3	489	1 755	97	98
329	Charleston	Coles	9% RW	60.0	61.4	71.7	11.05	9.82	.440	56.2	493	1 745	96	97
331	Blackland	Macon	.....	59.3	60.8	69.5	12.67	10.43	.400	55.9	493	1 875	96	96
335	Pierson	Piatt	.....	58.5	59.8	70.6	11.43	10.13	.580	56.8	489	1 860	96	96
339	Oreana	Macon	.....	59.6	61.0	72.0	11.76	10.31	.470	57.1	490	1 635	95	95
341	Decatur	Macon	.....	59.8	61.5	72.2	11.78	9.64	.480	56.8	491	1 755	96	96
342	Fecklin	Douglas	.....	59.0	60.6	69.5	11.85	10.19	.420	55.6	485	1 740	97	96
344	Newman	Douglas	10% RW	60.0	61.7	71.8	11.86	10.41	.420	56.5	480	1 695	96	97
345	St. Francisville	Lawrence	.....	58.5	60.3	70.0	11.27	9.60	.400	50.6	473	1 775	97	98
351	Tremont	Tazewell	.....	57.7	59.7	72.0	11.93	10.49	.460	53.2	474	1 960	97	99
354	Redman	Edgar	.....	58.0	59.2	....	10.73	9.65	.440	54.7	474	1 720	95	96
358	Charleston	Coles	10% RW	59.2	60.3	70.4	11.44	9 88	.410	51.2	475	1 725	96	96
365	Dalton City	Moultrie	.....	58.5	60.1	70.7	11.45	9.87	.420	52.9	477	2 015	97	99
370	Mechanicsburg	Sangamon	.....	59.7	60.5	70.3	11.20	9.90	.450	53.2	476	1 830	96	98
373	Thomasville	Montgomery	.....	58.9	60.2	72.0	10.92	9.63	.400	52.4	481	1 700	96	98
376	Maroa	Macon	.....	59.9	61.1	72.7	11.44	9.91	.410	52.6	478	1 855	95	95
378	Ashmore	Coles	.....	59.1	60.5	71.3	9.45	8.34	.460	53.2	478	1 810	96	99
379	Kansas	Edgar	.....	59.0	60.6	71.9	10.64	9.52	.490	52.9	480	1 735	95	99
384	Murrayville	Morgan	YHW	59.6	61.1	71.1	10.39	8.80	.410	52.6	480	1 760	97	99
387	Ashmore	Coles	.....	59.2	60.7	72.8	10.63	8.86	.450	54.4	484	1 790	95	95
	Average		.....	59.1	60.7	71.1	11.21	9.70	.433	54.4	483	1 777	96	97.1
	Average of all hard winter		.....	59.5	60.9	71.5	11.35	9.86	.439	54.7	483	1 797	95.9	96.9

TABLE 19.—*Continued*

Sample No.	Source		Inspector's notes	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb
	Town	County		Uncleaned	Cleaned		Wheat	Flour						
						No. 1 soft red winter								
				lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*
390	Rapatee	Knox		59.2	61.3	74.0	10.63	9.34	.460	53.2	477	1 880	95	95
						No. 2 soft red winter								
327	Unknown	Unknown		59.1	60.6	70.9	10.50	9.39	.330	55.3	481	1 810	98	98
332	Newman	Douglas		58.7	60.0	70.0	11.71	9.48	...	54.1	485	1 800	97	96
333	St. Francesville	Lawrence		58.6	60.0	71.0	10.99	9.65	.360	54.1	478	1 870	97	97
336	Pinkstaff	Lawrence		59.2	60.2	71.2	10.89	9.06	.390	57.4	482	1 775	97	97
346	Newman	Douglas		59.5	61.1	71.4	12.51	10.54	.340	54.1	478	1 960	98	100
359	Menert	Tazewell		58.3	59.8	72.5	10.35	8.94	.390	51.8	470	1 860	97	98
368	Carlinville	Macoupin		58.7	60.0	71.0	10.95	9.36	.400	52.1	473	1 770	96	98
369	Irving	Montgomery		58.4	60.2	72.7	10.30	8.78	.446	52.1	475	1 750	96	98
371	Vandalia	Fayette		59.2	60.5	72.0	11.08	9.71	.420	50.9	475	1 680	97	97
374	Wamas	Marion		59.2	60.8	74.3	10 41	9.37	.450	51.5	470	1 755	96	98
381	Mt. Auburn	Christian		59.0	60.6	70.8	11.86	10.30	.440	52.4	473	1 800	98	99
382	Hillsboro	Montgomery		58.5	60.3	71.3	10.75	9.00	.430	52.4	467	1 790	97	99
386	E. Fort Madison	Hancock		57.9	59.4	72.3	9.91	8.46	.430	52.1	473	1 640	96	85
388	Missouri	Edgar		59.2	60.5	73.5	11.41	10.41	.350	53.2	474	1 870	97	98
389	Hornsby	Macoupin		59.7	60.8	71.6	10.28	9.25	.360	52.9	476	1 730	97	98
392	Williamsville	Knox		59.4	60.6	73.8	11.02	9.44	.380	52.4	477	1 900	96	97
	Average			58.9	60.3	71.9	10.93	9.45	.394	53.1	475	1 798	96.9	97
						No. 3 soft red winter								
383	Kane	Greene		57.7	59.1	71.1	10.74	9.21	.420	52.1	474	1 700	96	97
	Average of all red winter			58.9	60.3	72.0	10.90	9.43	.400	53.0	475	1 797	96.7	96.9

TABLE 19.—*Concluded*

Sample No.	Source		Inspector's notes	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb
	Town	County		Uncleaned	Cleaned		Wheat	Flour						
						No. 1 mixed								
				lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*
321	Hume	Edgar	55 HW, 45 RW	59.4	61.3	68.8	10.28	8.55	.370	54.7	481	1 675	97	96
340	Green's Switch	Macon	80 HW, 20 RW	59.8	61.8	70.5	11.98	10.67	.510	55.0	487	1 855	97	98
348	Newman	Douglas	84 HW, 16 RW	59.5	60.6	70.3	10.91	9.13	.480	57.9	494	1 640	95	95
355	Iroquois	Iroquois	.....	59.1	60.4	71.1	11.01	9.71	.420	53.0	470	1 950	98	98
362	Newman	Douglas	80 HW, 20 RW	59.3	60.3	72.3	11.14	9.03	.386	54.1	474	1 815	96	95
	Average	.....	.....	59.4	60.9	70.6	11.06	9.42	.433	54.9	481	1 787	96.6	96.4
						No. 2 mixed								
320	Menert	Tazewell	60 HW, 40 RW	58.0	59.3	65.7	12.69	10.91	.450	55.6	492	1 850	97	98
322	Newman	Douglas	84 RW, 16 HW	57.9	60.0	66.4	11.15	9.14	.320	54.1	488	1 695	97	95
326	Unknown	Unknown	84 RW, 16 HW	59.0	60.6	70.2	10.68	8.94	.440	56.8	488	1 830	98	98
337	Newman	Douglas	65 HW, 35 RW	59.2	60.7	72.1	11.64	10.15	.420	54.1	487	1 785	97	96
352	Decatur	Macon	80 RW, 20 HW	58.6	59.8	70.2	11.53	9.53	.440	52.6	481	1 625	96	96
356	Leslie	Tazewell	60 HW, 40 RW	59.1	60.4	72.6	10.98	9.52	.470	53.8	484	1 785	96	97
363	Charleston	Coles	75 HW, 25 RW	58.6	59.7	72.2	11.47	9.76	.390	....	481	1 855	96	98
366	Kansas	Edgar	72 RW, 28 HW	58.8	59.8	72.4	11.00	9.52	.410	51.8	467	1 700	96	96
367	Shelbyville	Shelby	62 RW, 38 HW	59.0	60.6	71.7	11.67	10.46	.350	52.4	482	1 800	96	97
372	Hammond	Piatt	70 HW, 30 RW	59.7	61.2	71.2	11.79	9.95	.470	52.4	473	1 770	95	96
375	Maroa	Macon	85 HW, 15 RW	60.1	61.4	73.8	11.41	10.12	.420	52.1	472	1 775	95	95
377	Mt. Auburn	Christian	70 HW, 30 RW	59.7	60.9	71.4	11.38	10.19	.350	53 5	481	1 835	96	98
380	Unknown	Unknown	80 RW, 20 HW	59.8	61.1	70.6	10.84	9.28	.450	52.9	478	1 770	97	99
385	Kansas	Edgar	75 RW, 25 HW	58.9	60.4	68.7	10.38	8.75	.390	52.4	472	1 790	96	98
	Average	.....	.....	59.0	60.4	70.7	11.33	9.73	.412	53.4	480	1 776	96.3	96.9
	Average of all mixed wheat	.....	.....	59.1	60.5	70.7	11.26	9.65	.418	53.8	481	1 779	96.4	96.8

TABLE 20.—ANALYTICAL DATA AND RESULTS OF MILLING AND BAKING TESTS OF SAMPLES OF WHEAT RECEIVED FROM FARMERS IN CENTRAL ILLINOIS, CROP OF 1925

Sample No.	Town	County	Class	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb
				Uncleaned	Cleaned		Wheat	Flour						
				lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*
145	Plainfield	Will	HRW	62.8	64.0	71.4	11.68	10.00	.465	51.5	487	1 550	96	100
166	Plainfield	Will	HRS	62.0	63.1	76.2	13.12	11.92	.540	53.5	468	1 950	98	98
155	Hartsburg	Logan	HRW	60.4	62.0	72.6	10.54	9.09	.448	49.7	465	1 915	96	99
158	Lincoln	Logan	SRW	57.7	59.1	71.2	10.68	9.54	.479	51.2	467	1 760	96	90
161	Lincoln	Logan	HRW	58.8	60.8	73.5	10.49	9.29	.485	54.1	483	1 825	97	99
159	Yates City	Knox	HRW	61.6	62.9	74.7	10.12	9.23	.546	55.3	486	1 750	97	98
164	Williamsfield	Knox	HRW	61.1	62.4	74.6	10.88	9.80	.520	55.3	482	2 135	97	100
160	Urbana	Champaign	HRW	61.5	63.0	74.8	13.10	11.74	.560	52.9	474	1 835	97	97
162	Pekin	Tazewell	HRW	61.1	62.3	73.7	12.47	11.19	.548	53.8	492	1 815	97	98
169	Hamilton	Hancock	HRW	59.9	61.5	75.3	11.02	9.86	.537	54.4	485	1 990	96	97
172	Sidell	Vermilion	(1)	60.6	62.5	75.3	10.72	.....	.557	54.4	481	1 800	96	95
201	Cambridge	Henry	HRW	62.5	63.9	69.9	11.11	10.18	.514	59.7	498	2 000	96	96
	Average			60.8	62.3	73.6	11.33	10.17	.517	53.8	481	1 860	96.6	97.3

[1]Class unknown.

TABLE 21.—ANNUAL MILLING AND BAKING DATA OF VARIETIES OF SPRING WHEAT GROWN ON EXPERIMENT FIELDS AT URBANA, CHAMPAIGN COUNTY, AND AT DEKALB, DEKALB COUNTY

Variety, sample No., and year	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
	Uncleaned	Cleaned		Wheat	Flour							
Urbana experiment field												
Kota	*lbs.*	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
48 1924	60.6	64.2	70.8	13.73	12.45	.514	57.4	485	1 940	98	99	27.0
313 1925	61.9	63.5	72.8	14.62	13.36	.502	63.5	509	2 120	98	99	26.7
467 1926	61.9	63.4	76.7	14.99	13.49	.515	52.9	478	2 045	96	100	28.1
Average	61.5	63.7	73.4	14.45	13.10	.510	57.9	491	2 035	97.3	99.3	27.3
White Australian												
44 1924	60.0	62.8	78.7	12.64	10.97	.474	50.6	475	1 680	98	100	36.9
310 1925	60.8	62.2	73.3	13.84	12.99	.771	53.5	472	2 150	99	100	25.7
463 1926	59.4	60.9	76.4	14.08	12.52	.501	50.3	470	1 965	98	98	29.0
Average	60.1	62.0	76.1	13.52	12.16	.582	51.5	472	1 932	98.3	99.3	30.5
Marquis												
46 1924	57.9	62.4	75.8	12.29	11.17	.539	55.6	485	1 895	97	99	33.7
316 1925	61.7	63.0	74.6	13.78	12.56	.533	59.7	505	1 645	97	97	27.3
465 1926	60.7	62.3	74.5	13.71	12.39	.535	50.6	476	1 900	96	97	34.4
Average	60.1	62.6	75.0	13.26	12.04	.536	55.3	489	1 813	96.7	97.7	31.8
Illinois No. 1												
45 1924	59.9	62.5	73.4	13.93	12.87	.543	53.8	...	1 695	98	99	36.1
311 1925	61.5	62.8	72.1	14.88	13.40	.465	59.1	498	1 860	97	96	28.1
466 1926	61.6	63.2	72.4	12.02	10.71	.488	49.7	475	1 795	96	95	34.7
Average	61.0	62.8	72.6	13.61	12.33	.499	54.2	486	1 783	97.0	96.6	33.0
Wisconsin Wonder												
47 1924	61.2	64.2	74.5	15.61	13.48	.488	53.8	472	1 810	97	90	26.9
318 1925	60.8	62.5	72.8	14.75	13.88	.511	56.8	491	1 725	97	96	20.6
Average	61.0	63.4	73.7	15.18	13.68	.500	55.3	481	1 767	97.0	93.0	23.8
Blue Ribbon												
43 1924	60.8	63.2	75.1	12.46	11.04	.508	53.2	479	1 630	97	98	33.4
319 1925	63.0	64.3	69.2	14.61	13.07	.488	59.4	510	1 810	97	97	22.3
Average	61.9	63.8	72.2	13.54	12.05	.498	56.3	494	1 720	97.0	97.5	27.9
Progress												
462 1926	62.7	63.7	74.6	13.27	11.25	.469	50.9	476	1 965	98	98	33.1
Dicklow												
469 1926	52.4	54.4	72.4	9.96	8.81	.597	50.3	473	1 820	97	97	19.5
Garnet												
470 1926	61.8	63.5	76.8	11.41	10.39	.576	52.9	484	1 615	95	95	....
Grand average	60.6	62.6	74.0	13.50	12.15	.527	54.4	484	1 845	97.2	97.4	29.1

TABLE 21.—*Concluded*

Variety, sample No., and year	Weight per bushel		Flour yield	Crude protein (Nx5.7)		Ash of flour	Water absorbed	Weight of loaf	Volume of loaf	Color of crumb	Texture of crumb	Grain yield per acre
	Uncleaned	Cleaned		Wheat	Flour							
DeKalb experiment field												
	lbs.	*lbs.*	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*gms.*	*cc.*	*perct.*	*perct.*	*bu.*
Marquis												
65 1924	55.9	59.9	72.5	12.54	11.20	.505	55.3	475	2 245	99	100	30.7
305 1925	56.8	59.2	70.0	14.04	13.06	.545	60.3	492	2 090	96	96	27.2
410 1926	52.2	56.8	70.3	11.34	10.19	.480	50.9	467	1 880	96	98	24.5
Average	55.0	58.6	70.9	12.64	11.48	.510	55.5	478	2 072	97.0	98.0	27.5
Kota												
66 1924	52.0	59.2	71.9	14.76	12.69	.650	55.3	471	2 110	94	95	27.5
258 1925	57.2	59.7	72.4	14.61	.....	.595	58.5	495	2 000	97	101	25.4
412 1926	53.5	58.3	74.0	12.99	11.71	.450	52.9	474	1 410	90	80	20.8
Average	54.2	59.1	72.8	14.12	.....	.565	55.6	480	1 840	93.7	92.0	24.6
Illinois No. 1												
64 1924	55.4	59.9	71.0	13.18	11.96	.525	51.8	469	1 910	95	90	30.5
257 1925	59.5	61.9	69.9	13.85	13.09	.503	55.9	488	1 760	96	90	34.1
409 1926	55.6	59.3	72.7	11.10	10.00	.390	50.0	473	1 800	97	96	23.9
Average	56.8	60.4	71.2	12.71	11.68	.473	52.6	477	1 823	96.0	92.0	29.5
Blue Ribbon												
63 1924	55.9	60.5	73.7	12.84	11.03	.457	....	467	1 970	95	85	28.8
Wisconsin Wonder												
249 1925	58.4	61.5	72.8	15.36	14.63	.543	56.5	488	2 010	97	100	23.6
Progress												
408 1926	58.9	....	73.9	11.14	10.39	.400	48.8	463	1 820	97	98	28.2
White Australian												
418 1926	51.0	55.1	76.1	11.61	10.66	.400	52.4	...	2 030	92	92	22.6
Grand average	55.5	59.3	72.4	13.03	11.72	.496	54.1	477	1 926	95.5	93.9	26.8